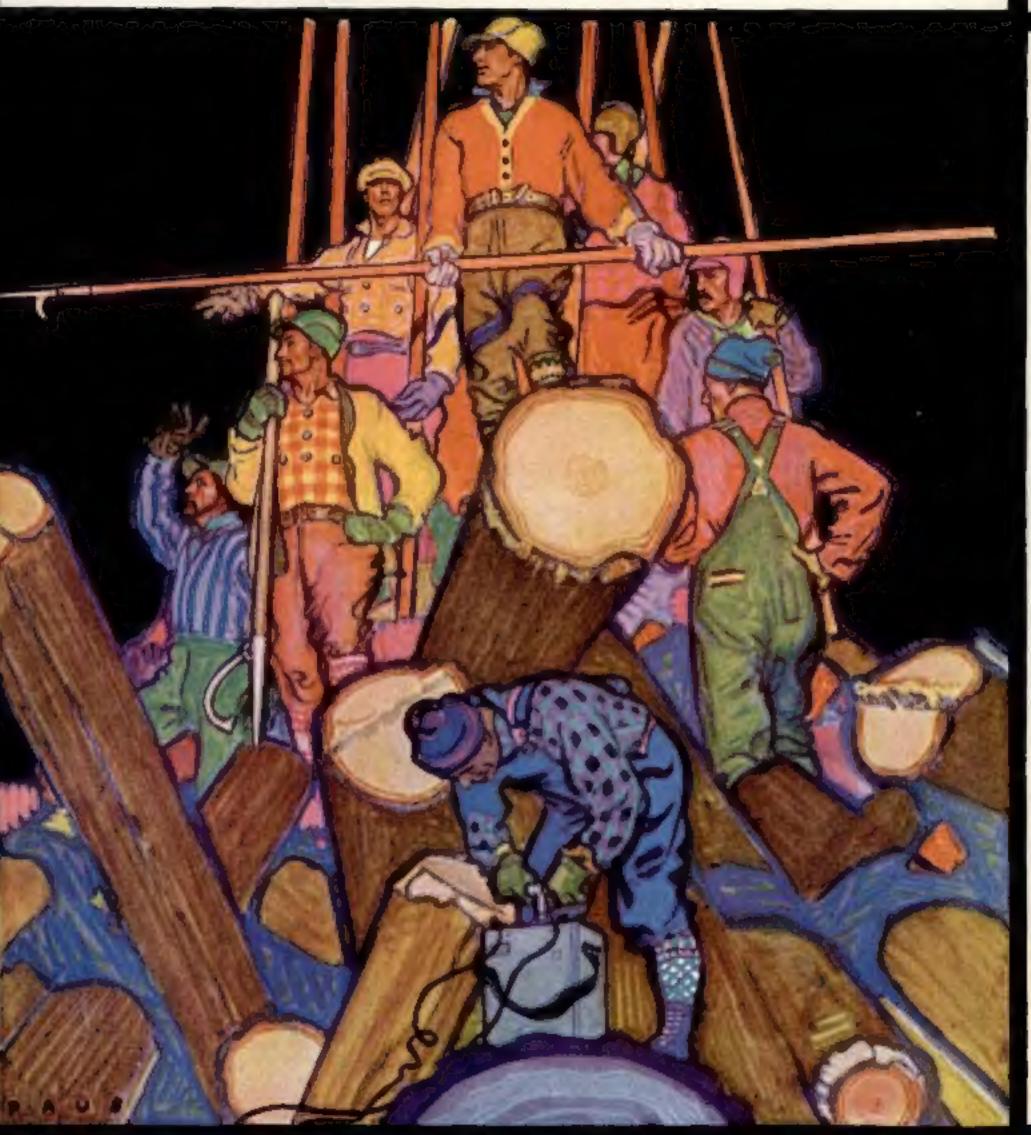
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WHAT IS NEW THIS MONTH

Table of Contents for March

LEADING ARTICLES	7	Automobiles
MAKING SCHMARINES SAVE By John Walker Harrington	13	"Road Yacht" Complete Home 52
The tragedy of the S-3 sinking, and what it taught the Navy Is Lost Explores Now Jungle God?	10	Who Is Father of Automobile? 54 Paving Put to Test. 54 Open Car and Sedan in One . 59
Weird possibilities binted by a mysterious disappearance WHY WE ARE IMMUNE TO SOME DISEASES . By Lidda Kay	21	Garage Door Dogs 81 Novel One-Wheel Luggage Carrier
First steps that foretell greater medical conquests to come "We" SMASH MORE RECORDS	23	for Motor Care 61 Know Your Car 62
The amazing mechanical performance of Col. Lindbergh's place ROMANCE JAMA THE LOG JAMA	24	New Paint Striping Device Lets Anyone Decorate Auto (g)
What veteran lumbermen do when the spring drive comes down SPERRY—Competition of the Sun . By Frank Parker Stockbridge	26	A Bed in a Motor Car
The story of a mechanical genius, his searchlights, and his gyros WHERE DED YOU CAYCH COLD?	28	Back Through Garage Doors
New things doctors are learning about contagion and overesting A NEW BROOD OF LENDREBURS By Maj. Gen. James E. Fechel	22	Swinging Stop Light
How the Army is teaching fledglings to fly Bits of Old Clay Kick Up a Big Row By George Lee Dowd, Jr.	81	Acteonomy
An archeological "find" that started a scientific battle. The Real Story behand the New Ford Car. By Edwin Ketchum.	32	Astronomy Sun's Collapse Predicted
How one man's ingenuity met a great industrial crisis WHAT WE OWE TO NEWTON	34	Big New Meteorite Studied 42 Star a Pulsating Gas Bubble 50
The story of a young farm boy who explained the universe TRIUMPHS OF RADIO'S "HAMS" By Alden P. Armagnac	39	
How amateur tie-ups span continents and serve nations SEA WAYES TO DRIVE NOVEL POWER PLANT	41	Aviation Ol Engine and Cheap Helium May
How a Navy engineer would harness the occan's energy The Worldo's Greatest Timber Crop	42	Start New Flying Epoch 51 Navy Issues Ocean Air Maps 55
A single island's colonest industry OUR BATTLESHIPS ON WHEELS	44	Globe-Circling Dirigible Nears Com-
By Rear Admired Charles P. Plunkett, U. S. N. How American naval gams turned the tide in France		First Aspurite Air Olider 57 Barbed Anchor Aids Airships 57
Ronning Fog of I'rs Perils	17	First Floating Dock for Scanlanes 57
COAL Too Untifut to Built	400	Scaplane Can Go 4000 Miles 58
PLANTS MADE BY CHEMISTRY Laboratory creations that almost outdo nature	AM.	Planes Use Costliest Wood at \$600 for Thousand Feet 38
HE REBUILT HIS HOUSE AND SAVED \$6,000. By John R. McMahon Making a convertible home for one or two families		New Light's Colored Rays Fight Fog 61
WHEN YOU BUY A CAR- Gus and Joe tell how "service" and "trade allowance" affect your choice	74	Engineering
DECIDING WHAT TOOLS ARE GOOD	10	Artificial Gales Test Skyactaper Models 50
		Dam Holds Water with Water 53 Plan to Utilise Moon Power 53
FICTION	10	Twin Panama Canal Foreseen 54 Dam Is Engineering Fent 54 Heating Plants on Roofs Next 7 55
ALL METAL By Andrew A. Coffrey A high-genred story of an air liner, a girl, and a dramatic rescue at sea The Movie Makes—Part Two By S. W. Newmeyer	36	Steam Well Power Unlimited 58
Thrills that the cinema audience sever nes, in a fascinating novel	20	A \$275,000 Floating Road 58 Bridge Nearly 500 Feet High 58 Engineers World News Service 64
RADIO		Monorail Cars Under River
LOCATING YOUR RADIO TROUBLE By Alexander Sensules		Health and Hygiene
A GUIDE IN CHOOSING A RADIO SET	70 82	Skeletons That Teach Health
THE HOME WORKSHOP		Blood Pressure and Motoring
THE HOME WORKSHOP THE SIMPLEST FLYING MODEL . By J. D. Bunch and A. F. Koch	81	Why Boys Eat So Much 65 New Gains in War on Disease U38
TRICKS OF THE TOOLMAKER By Hector J. Chamberland	88	Perfumed Anesthetic Is Latest 132

Nurch, 1928, Vol. 112, No. 8. Papeslay Science Manchly is published monthly at 200 Fourth Avenus, New York, N. Y. by the Popular Science Publishing Cu., Inc. Entered as second-class matter Dyn. 28, 1918, at the Four Office at New York under the act of March 2, 1979, additional entry as second-class matter at Chicago, Illinois. Entered as second-class matter at the Post Office Department, Canada. Printed in U. H. A. Copyright, 1937, by the Popular Science Publishing Co., Inc. Single copy, 35 cents. Yearly subscriptions to

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Laboratory Discoveries	1
Health Rays Fierce Clother Holes	-
Alone, Tests Show 51	1
Gunt Plant from X-Rayed Seed . 51	
Sky Plays with Sound Waves . 62	
Cheap Cornetalk Walls Now 63	
Sugar Produced by Chemistry 64	
A Wireless Electric Light 138	Н
New Devices for the Home	
New Knife Grinder (2)	
Portable Electric Radiutor	
Door Knob Burglar Alarm 66	Н
Poisons Safeguarded in Novel Med-	
icine Chest 60	
Bread Cabinet Hides Goodies in	
Secret Comparingent 86	
Speedy One-Hand Flour Sifter 08 Reversible Resear Saves Bristles 06	
Hardy Funnel Fills Your Radiator	
Water Pans	
Table and Radiates in One	
Keeps Your Clothespins in Beach 67	
Novel Srissors Adjustable for Wear 67	
Bakes Potato in One Minute 67	
New Cooker Saves Flavor 67	
Makes Siphon of Your Ginger Ale	
Bottis	
New Launder Ray Holder #7	_
Mends Sagging Upholstered Chairs . 67	
New Processes and	
Inventions	
Turns Sound to Light to Help Deaf	
Hour 51	
Saw Uses Sand to Cut Rock 59	
Gear-Wheeled Roller Skales 52	
Portable Track for Racing Grey-	
homads äs	
Wheels Made of Cotton 55	
New Way to Tell Time is Bed . 58	
New Chemical "Ice" for Itale 58 Steel House Exected in Little Over	
Three Hours 59 Footproof Elevator 59	
Magnifying Your Strength 39 Phonograph Relieves Phone Girls 60	_
A Vest Pocket Ash Tray 00	_
Eggs Kept Fresh by Daily Ride on	
Forris Whood	

Ending Nuisance of Wet Umbrella	60
Novel Golf Scorer in Watch Case	100
What a Harmonies Grows Up to Be	60
Bundle-Tytag Device	-61
A Slot Machine Soda Fountain	e!
Old Envelope Licker	-61
Novel Saw Cuts 24 Piles in 50	_
Minutes	199
Playing Cards in Tile Form Dely	
Wind and Hard I sage	62
Clock Times Life of Truck	65
A Mechanical Professor Electric Signs Flash Paris News	93
D D .	64
de al 1 de la companya de la company	65
Optical Device Gages Heat	0.3
Photography	
Photos of Heart Electricity	2.1
Toud Challenges Camera's Speed	31
Ford Chainings Catalogs a Speed	65
Radio	
Hotel Radio in Each Room	33
Du Radio Wayes Never Die F	15
Unusual Facts and Idea	121
Unusual Facts and Idea	
Was America Man's Birthplace?	50
Was America Man's Birthplace? Creeping Baby Is Trotter.	31
Was America Man's Birthplace? Creeping Baby 1s Trotter Municipes Sought in Arctic	50 31 31
Was America Man's Birthplace? Crooping Raby Is Trotter. Municales Sought in Arctic Insects Turned to Metal.	50 31 31 31
Was America Man's Birthplace? Cropping Raby Is Trotter. Munnales Sought in Arctic Insects Turned to Metal Bottle Traces Ocean Current	50 31 31
Was America Man's Birthplace? Crooping Raby Is Tratter. Munnales Sought in Arctic Insects Turned to Metal Bottle Traces Ocean Current How to Name a New Animal	31 31 31 31 31
Was America Man's Birthplace? Cropping Raby Is Trotter. Munnales Sought in Arctic Insects Turned to Metal Bottle Traces Ocean Current	31 31 31 31 31
Was America Man's Birthplace? Crooping Raby Is Tratter. Municipal Sought in Arctic Insects Turned to Metal. Bottle Traces Ocean Current How to Name a New Animal Swastika May Trace Races to Lost Parific Continent Self-Sprinkling Roods Built	51 51 51 52 52
Was America Man's Birthplace? Crooping Raby Is Tratter Municipal Sought in Arctic Insects Turned to Metal Bottle Trates Ocean Current Here to Name a New Amunal Swastika May Trace Races to Lost Parific Continent Self-Sprinkling Roads Built Sea Lions Caught with Nets	50 31 31 31 32 32 32 38 38 38 38 38 38 38 38 38 38
Was America Man's Birthplace? Crooping Raby Is Tratter. Municipal Sought in Arctic Insects Turned to Metal. Bottle Trates Ocean Current Here to Name a New Amount Swastika May Trace Races to Lost Parific Continent Self-Sprinkling Roads Built Sen Lions Cangut with Nets Fixe-Mile Road of Gold Oce	50 51 51 52 52 53 53 53
Was America Man's Birthplace? Crooping Raby Is Tratter. Munically Sought in Arctic Insects Turned to Metal Bottle Traces Ocean Current Here to Name a New Animal Swastika May Trace Races to Lost Pacific Continent Sell-Sprinkling Roads Built Sea Lions Caught with Nets Fixe-Mile Bond of Gold Oce Jank Makes Queer Golf Links	50 51 51 52 52 53 53 53 53
Cropping Raby Is Trotter. Munical Sought in Arctic Insects Turned to Metal. Bottle Traces Ocean Current How to Name a New Animal. Swastika May Trace Races to Lost Pacific Continent. Sell-Sprinkling Roads Built. Sea Lions Cangut with Nets. Fixe-Mile Road of Gold Oce. Jank Makes Queer Golf Links. Mad Trapped by the Desert.	50 51 51 52 52 53 53 53 53 53
Was America Man's Burthplace? Crooping Raby Is Trotter. Munnales Sought in Arctic Insects Turned to Metal Bottle Traces Ocean Coarcut How to Name a New Animal Swastika May Trace Races to Lost Pacific Continent Sell-Sprinkling Roads Built Sea Lions Cangut with Nets Fixe-Mile Road of Gold Oce Junk Makes Queer Golf Links Mad Trapped by the Desert On Ditch a Fabric Pattern	50 51 51 52 52 53 53 53 53 53 53 53
Was America Man's Birthplace? Crooping Raby Is Trotter. Municial Sought in Arctic Insects Turned to Metal Bottle Traces Ocean Cvarcut How to Name a New Animal Swastika May Trace Races to Lost Pacific Continent Self-Sprinkling Roads Built Sen Lions Caught with Nets Five-Mile Bond of Gold Oce Junk Makes Queer Golf Links Mad Trapped by the Desert On Ditch a Fabric Pattern Smaller Dullars Save Millions	50 51 51 52 52 53 53 53 53 53 53 53 53 53 53
Was America Man's Birthplace? Crooping Raby Is Tratter. Municial Sought in Arctic Insects Turned to Metal. Bottle Traces Ocean Current How to Name a New Animal Swastika May Trace Races to Lost Pacific Continent Self-Sprinkling Roads Built Sea Lams Caught with Nets Five-Mile Road of Gold Oce Junk Makes Queer Golf Links Mad Trapped by the Ocean Oil Ditch a Fabric Pattern Smaller Dullars Save Millions Making All Russia Gas-Proof	50 51 51 52 52 53 53 53 53 53 53 53
Was America Man's Buttsplace? Crooping Raby Is Tratter Municial Sought in Arctic Insects Turned to Metal Bottle Traces Ocean Current How to Name a New Animal Swastika May Trace Races to Lost Pacific Continent Self-Sprinkling Roads Built Sea Lions Caught with Nets Five-Mile Bond of Gold Oce Jank Makes Queer Golf Links Mad Trapped by the Desert Oil Ditch a Fabric Pattern Smaller Dullars Save Millions Making All Russia Gas-Proof Building Wreekers Instate Explo-	50 51 51 52 52 53 53 53 53 53 53 53 53 53 53
Was America Man's Buttsplace? Crooping Raby Is Tratter. Municial Sought in Arctic Insects Turned to Metal. Bottle Traces Ocean Current How to Name a New Animal Swastika May Trace Races to Lost Pacific Continent Self-Sprinkling Roads Built Sea Lions Caught with Nets Five-Mile Road of Gold Oce Jank Makes Queer Golf Links Mad Trapped by the Desert On Ditch a Fahrie Pattern Smaller Dullars Save Millions Making All Russia Gas-Proof Building Wreekers Initiate Explo- sion	50 51 51 52 52 53 53 53 53 53 53 53 53 53 53
Was America Man's Buttsplace? Crooping Raby Is Tratter Municial Sought in Arctic Insects Turned to Metal Bottle Trates Ocean Current How to Name a New Animal Swastika May Trace Rates to Lost Pacific Continent Self-Sprinkling Roads Built Sea Lions Caught with Nets Five-Mile Road of Gold Ore Jank Makes Queer Golf Links Mad Trapped by the Desert On Ditch a Fabric Pattern Smaller Dullars Save Millions Making All Russia Gas-Proof Building Wreekers Instate Explo- sion Bens Smash Laying Records	50 51 51 52 52 53 53 53 53 53 53 53 53 53 53
Was America Man's Buttsplace? Crooping Raby Is Tratter Municias Sought in Arctic Insects Turned to Metal Bottle Trates Ocean Current How to Name a New Amunal Swastika May Trace Rates to Lost Pacific Continent Self-Sprinkling Roads Built Sea Lions Caught with Nets Fixe-Mile Road of Gold Ore Jank Makes Queer Golf Links Mad Trapped by the Desert On Ditch a Fabric Pattern Smaller Dollars Save Millions Making All Russia Gas-Proof Building Wreekers Instate Explo- sion Bens Smash Laying Resords Tray Car Chiens Speed Mark	50 51 51 52 52 53 53 53 53 53 53 53 53 53 53
Cropping Raby Is Trotter Municipal Sought in Arctic Insects Turned to Metal Bottle Traces Ocean Current Hore to Name a New Animal Swastika May Trace Rates to Lost Pacific Continent Sell-Sprinkling Roads Built Sea Lions Caught with Nets Fixe-Mile Road of Gold Ore Jack Makes Queer Golf Links Mad Trapped by the Desert On Ditch a Fabric Pattern Smaller Dollars Save Millions Making All Russia Gas-Proof Building Wreekers Instate Explosion Bens Smash Laying Records Toy Car Chems Speed Mark Rahoons As Servants Advised	50 51 51 52 52 53 53 53 53 53 53 53 53 53 53
Croping Raby Is Trotter Municipal Sought is Arctic Insects Turned to Metal Bottle Traces Ocean Current How to Name a New Animal Swastika May Trace Races to Lost Pacific Continent Self-Sprinkling Roads Built Sea Lions Caught with Nets Five-Mile Bond of Gold Oce Jank Makes Queer Golf Links Mad Frapped by the Desert On Ditch a Fabric Pattern Smaller Dullars Save Millions Making All Russin Gas-Proof Building Wreekers Institute Explo- sion Bens Smash Laying Resords Tray Car Chemy Speed Mark Rahesons As Servants Advised Trees Gage Wind Velocity	500 511 512 522 523 523 523 523 523 523 52
Cropping Raby Is Trotter Municipal Raby Is Trotter Municipal Sought in Arctic Insects Turned to Metal Bottle Traces Ocean Current Here to Name a New Animal Swastika May Trace Rates to Lost Pacific Continent Self-Sprinkling Roads Built Sea Lions Caught with Nets Fixe-Mile Road of Gold Ore Junk Makes Queer Golf Links Mad Trapped by the Desert On Ditch a Fabric Pattern Smaller Dollars Save Millions Making All Russin Gas-Proof Building Wreekers Instate Explosion Bens Smash Laying Records Tree Car Chems Speed Mark Rahoons As Servants Advised Trees Gage Wind Velocity Any Questions	500 511 511 522 523 523 523 523 523 523 523
Cropping Raby Is Trotter Municipal Raby Is Trotter Municipal Sought in Arctic Insects Turned to Metal Bottle Traces Ocean Current Here to Name a New Animal Swastika May Trace Races to Lost Parific Continent Self-Sprinkling Roads Built Sea Lions Cangut with Nets Fixe-Mile Bond of Gold Oce Junk Makes Queer Golf Links Mad Trapped by the Desert Oil Ditch a Fabric Pattern Smaller Dullars Save Millions Making All Russin Cas-Proof Building Wreekers Initiate Explosion Bens Smoot Laying Records Trees Cage Wind Velocity Any Questions Bright Cashiren Not "Queer"	50 51 51 52 53 53 53 53 53 53 53 53 53 53
Cropping Raby Is Trotter Municipal Raby Is Trotter Municipal Sought in Arctic Insects Turned to Metal Bottle Traces Ocean Current Here to Name a New Animal Swastika May Trace Rates to Lost Pacific Continent Self-Sprinkling Roads Built Sea Lions Caught with Nets Fixe-Mile Road of Gold Ore Junk Makes Queer Golf Links Mad Trapped by the Desert On Ditch a Fabric Pattern Smaller Dollars Save Millions Making All Russin Gas-Proof Building Wreekers Instate Explosion Bens Smash Laying Records Tree Car Chems Speed Mark Rahoons As Servants Advised Trees Gage Wind Velocity Any Questions	500 511 511 522 523 523 523 523 523 523 523

How Much Do You Know of the	
World You Live Inf	65
Tree Stump an Incinerator	433
Old Cement Mine a 40-Acre Mush-	
toom Farm	65
"Coldest Spot " Is 452 Below	0.5
Phone Insulators' Bath Day	65
For the Home Owner	
Elling Buthroom Cracks	103
How to Coneval Cracks in Plaster	10-3
Scaling Fite Cracks	104
Plumbing Hints for House Owners .	130
Hints for the Mechani	ic
Using Gears for Indexing Work on	
the Grinder	90)
Depth Gage for Lathe Drilling	1913
Bench Block Fitted to Hold Thin	20
Metal	90
Universal Joint for Floating Remort	1913
Indexing Fixture for Engine Lathe .	190
Ideas for the Handy Mo	
How to Care for Your Tools	86
How to Care for Your Tools. How to Lay Out Your Own Shop for	86
Hen to Care for Your Tools. How to Lay Out Your Own Shop for Description Metal Work	86 92
Hea to Care for Your Tools. How to Lay Out Your Own Shop for Description Metal Work. Somewraft - the Exterior Set.	86 92 94
Hea to Care for Your Tools. How to Lay Out Your Own Shop for Description Metal Work. Schoeraft - the Exterior Set. Tools - Pride of My Farm	92 94 96
Hea to Care for Your Tools. How to Lay Out Your Own Shop for Description Metal Work. Schoeraft - the Exterior Set. Tools - Pride of My Farm	86 92 94
Hea to Care for Your Tools. How to Lay Out Your Own Shop for Duscrative Metal Work. Senceraft—the Exterior Set. Tools—Prote of My Parm Wood Turning Snapidied. Blueprints for Your Home Work-	92 94 96 98
Hea to Care for Your Tools. How to Lay Out Your Own Shop for Description Metal Work. Schoecraft - the Exterior Set. Tools - Pride of My Farm Wood Turning Snaphified. Blueprints for Your Home Workshop.	92 94 96 96 98 106
Hea to Care for Your Tools. How to Lay Out Your Own Shop for Dunmative Metal Work. Sensecraft - the Exterior Set. Tools - Prote of My Farm Wood Turning Simplified. Blueprints for Your Home Workshop. Palat Hemovers You Can Make	92 94 96 98
Hea to Care for Your Tools. How to Lay Out Your Own Shop for Dunmative Metal Work. Sensecraft - the Exterior Set. Tools - Prole of My Parm Wood Turning Simplified. Blueprints for Your Home Workshon. Palat Hemovers You Can Make. How to Remody White Paint's	92 94 96 96 98 106
Hea to Care for Your Tools. How to Lay Out Your Own Shop for Dunmative Metal Work. Sensecraft - the Exterior Set. Tools - Prole of My Parm Wood Turning Simplified. Blueprints for Your Home Workshon. Palat Hemovers You Can Make. How to Remody White Paint's	92 94 96 96 98 106
Hea to Care for Your Tools. How to Lay Out Your Own Shop for Description Metal Work. Sensecraft - the Exterior Set. Tools - Prote of My Farm Wood Turning Snaplified. Blueprints for Your Home Workshon. Paint Hemovers You Can Make. How to Remedy White Paint's Yellow Tool. Horseshoe Magnet an Aid in Home.	95 96 96 98 106 114 112
How to Lay Out Your Tools. How to Lay Out Your Own Shop for Description Metal Work. Sensecraft - the Exterior Set. Tools - Prote of My Farm Wood Turning Simplified. Blueprints for Your Home Workshon. Paint Removers You Can Make. How to Remody White Paint's Yellow Tool. Horseshop Magnet an Aid in Home Workshop.	92 94 96 96 98 106
Hew to Lay Out Your Tools. How to Lay Out Your Own Shop for Dustrative Metal Work. Schoecraft - the Exterior Set. Tools - Pride of My Farm Wood Turning Snaphified. Blueprints for Your Home Workshop. Paint Removers You Can Make. How to Remody White Paint's Yellow Tool. Horseshop Magnet an Aid in Home Workshop.	92 94 96 96 98 106 114 114
Hew to Lay Out Your Tools. How to Lay Out Your Own Shop for Dustrative Metal Work. Senceraft the Exterior Set. Tools Pride of My Farm Wood Toroing Snaphified. Blueprists for Your Home Workshop. Paint Removers You Can Make. How to Remody White Paint's Yellow Tool. Horseshop Magnet an Aid in Home Workshop. Keeping Nickel-Plated Hardware Bright.	95 96 96 98 106 114 112
Hea to Care for Your Tools. How to Lay Out Your Own Shop for Duscrative Metal Work. Senecraft the Exterior Set. Tools Prote of My Parm Wood Turning Snapidied. Blueprints for Your Home Workshop. Paint Removers You Can Make. How to Remedy White Paint's Yellow Tint. Horseshop Magnet an Aid in Home Workshop. Keeping Nickel-Plated Hardware Bright. A Small Plant Stand Anyone Can	92 94 96 98 106 118 114 114
Hea to Care for Your Tools. How to Lay Out Your Own Shop for Duscrative Metal Work. Senceraft the Exterior Set. Tools Prote of My Farm Wood Turning Snaplified. Blueprints for Your Home Workshop. Paint Removers You Can Make. How to Remedy White Paint's Yellow Test. Horseshop Magnet an Aid in Home Workshop. Keeping Nickel-Plated Hardware Bright. A Small Plant Stand Anyone Can Make.	95 94 96 98 106 114 114 114 114
Hea to Care for Your Tools. How to Lay Out Your Own Shop for Duscrative Metal Work. Secondary the Exterior Set. Tools—Prote of My Parm Wood Turning Simplified. Blueprints for Your Home Workshon. Paint Removers You Can Make. How to Remody White Paint's Yellow Tool. Horsesboe Magnet an Aid in Home Workshop. Keeping Nickel-Plated Hardware Bright. A Small Plant Stand Anyone Can Make. Dowel Sticks As Xylophone Keys.	95 94 96 98 106 114 114 114 114 120 125
Hea to Care for Your Tools. How to Lay Out Your Own Shop for Duscrative Metal Work. Secontally the Exterior Set. Tools—Prote of My Paria Wood Toroing Snapidied. Blueprints for Your Home Workshop. Paint Removers You Can Make. How to Remody White Paint's Yellow Tool. Horsesboe Magnet an Aid in Home Workshop. Keeping Nickel-Plated Hardware Bright. A Small Plant Stand Anyone Can Make. Dowel Sticks As Xylophone Keys Carpenters Level Used for Sighting	95 95 96 98 108 118 118 114 114 120 125
Hea to Care for Your Tools. How to Lay Out Your Own Shop for Dustrative Metal Work. Senceraft - the Exterior Set. Tools - Prote of My Parm Wood Toroing Simplified. Blueprints for Your Home Workshon. Paint Hemovers You Can Make. How to Remedy White Paint's Yellow Tool. Horsesboe Magnet an Aid in Home Workshop. Keeping Nickel-Plated Hardware Bright. A Small Plant Stand Anyone Can Make. Dowel Sticks As Xylophone Keys. Carpenters Level Used for Sighting Long Lines.	90 90 90 90 90 100 114 114 114 116 120 120
How to Lay Out Your Tools. How to Lay Out Your Own Shop for Durantive Metal Work. Schoetaft - the Exterior Set. Tools - Prole of My Paria Wood Toroing Simplified. Blueprists for Your Home Workshop. Paint Hemovers You Can Make. How to Remedy White Paint's Yellow Tool. Horsesboe Magnet an Aid in Home Workshop. Keeping Nickel-Plated Hardware Bright. A Small Plant Stand Anyone Can Make. Down Sticks As Xylonhone Keys. Carpenters Level Used for Sighting Long Lones. Razor Blades Aid Modelers.	90 90 96 98 108 114 114 114 114 120 125 129
Hea to Care for Your Tools. How to Lay Out Your Own Shop for Duscrative Metal Work. Secontraft - the Exterior Set. Tools - Prote of My Parm Wood Toroing Snapidied. Blueprints for Your Home Workshon. Paint Removers You Can Make. How to Remody White Paint's Yellow Tool. Horsesboe Magnet an Aid in Home Workshop. Keeping Nickel-Plated Hardware Bright. A Small Plant Stand Anyone Can Make. Dowel Sticks As Xylophone Keys. Carpenters Level Used for Sighting Long Cares. Razor Blades Aid Modelers. Planelong Biote for Home Owners.	90 90 90 90 90 100 114 114 114 116 120 120
How to Lay Out Your Tools. How to Lay Out Your Own Shop for Durantive Metal Work. Schoetaft - the Exterior Set. Tools - Prole of My Paria Wood Toroing Simplified. Blueprists for Your Home Workshop. Paint Hemovers You Can Make. How to Remedy White Paint's Yellow Tool. Horsesboe Magnet an Aid in Home Workshop. Keeping Nickel-Plated Hardware Bright. A Small Plant Stand Anyone Can Make. Down Sticks As Xylonhone Keys. Carpenters Level Used for Sighting Long Lones. Razor Blades Aid Modelers.	90 90 96 98 108 114 114 114 114 120 125 129

Are You Abreast of the Times?

If you can't answer the questions below, turn to the page indicated

- Has blood pressure any connection with auto accidents? (p. 51)
- Who will transmit for you, without charge, a radio message to anyone, anywhere! (p. 30)
- 3. What kimi of a cold is not contagous? (p. 48)
- 4. For what is Sir Isane Newton famous! (p. 34)
- 3. Why are we to have smaller dollar bills? (p. 33)
- What star is believed to be a publishing hubble of gus? (p. 50)
- Why did Henry Ford take small boys riding in the first of his new cars? (p. 32)
- 8. What is the result of the U. S. Bureau of Standards' \$30,000 investigation to find uses for farm waste? (p. 63)
- 9. Where is the coldest spot on earth? (p. 63)
- How can you use imaginary lines to make your house a convertible one or two-family dwelling? (p. 71)
- What is the latest invention of Elmer Sperry, perfecter of the gyrof (p. 27)
- 12. How does a new type of dam hold back water with water?

- Who is said to have a prior claim over that of Gottlich Daixner, German engineer, as the "father of the automobile?" (p. 54)
- 14. To what discuses can man, today, make himself immune?
 10, 22
- What is the proper way to bend bamboo, in making model airplanes? (p. 81)
- 16. What planet shoots huge volcanie bumbs into space? [p. 50]
- 17. How do new species of animals get their names? p. 52)
- Where is the American factory which, making wood alcohol from coal by a new process, may supply the whole United States? (p. 40)
- What "important archeological discovery" in called a boas by scientists of high repute? (p. 91)
- What chemist has at last duplicated rature's feat of making sugar and starch, as plants do, from water, aunshine, and carbon decade? (p. 01)
- \$1. Where does the Army Air Service teach young men to fly? (p. 20)
- 22. How do hunderjacks break a log jam when they can't find the key-log? (p. 34)
- 23. Can the waves be harmessed for electric power? (p. 41)



Independence

The courage and determination of our forefathers made possible our present National well-being. Thrift and the continuous purchase of sound securities will make possible for the provident, monetary independence in their declining years.

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How a Big Load Was Lifted from Harry Wilson's Mind

By WALLACE AMES, Financial Editor

THE family had finished its dinner early. Harry Wilson had about exhausted his evening paper and was ready for whatever might turn up. His wife was upstairs going through the nightly tussle with two lively youngsters, getting them stowed away to bed.

Ding-a-ling a-ling rang the telephone. Mr. Wilson answered. "Gee, I'd like to, Bob, but just hold the wire a minute while I check up with Vi.

"Oh, Vi!" Wilson called upstairs, "Bob Collins is on the 'phone. He and Nan want us to come over this evening. How about it?"

"Mercy, I wish we could, Harry," called his wife. "We always have a good time at the Collinses. But there is something I must get done tonight. Ask him to excuse us this time. Tell Nan I'll call her up tomorrow.'

"What's the big rush job for tonight, Vi?" inquired her husband, as

she came down stairs.

"Betty's new dress. I must get it finished so she can wear it at her birthday party tomorrow."

"Why, I thought Mrs. Bender was taking care of all your sewing," re-

marked Harry.

"She was over all day," explained Mrs. Wilson, "but there was so much to do she couldn't finish. Betry is so excited over this new dress that I want to finish it for her myself tonight.

"Mrs. Bender wanted to stay until the work was done. She's so willing, but I couldn't let her do it. She has three children of her own, you know. The youngest is only five. There is no one at home to look after them while their mother is out sewing and I hadn't the heart to let her stay after five.

"It's too bad Mrs. Bender has to be away from her children all day, but she must go out sewing to feed her family and keep a roof over their heads. I feel so sorry for her.

"According to neighborhood gossip," observed Mr. Wilson, "Mrs. Bender got a lot of insurance money

when her husband died."

"She did," replied Mrs. Wilson, as her flying fingers were finishing button holes and sewing on buttons. "There was \$10,000 and that is a lot of money. But the cemetery plot, burial expenses and other bills are up over \$1,000. and she invested the rest partly in vacant lots and partly in mining stock that didn't turn out so good.

"Mrs. Bender was telling me all about it this afternoon. The lots were supposed to be right on the road leading to the new bridge and the mining stock promised to pay 12%. The stock proposition turned out to be a fake and she will probably lose all she put in it. As you know, they finally changed the location for the new bridge. Some day Mrs. Bender will probably be able to sell her lots, but she will hardly get as much as she paid for them. In the meantime, she has to pay taxes and the is getting no income from her investment.

"That's tough," mused Harry. "But you'd think she'd have known better. I'll bet you wouldn't waste our insurance money like that."

"I hope not," said Vi, with semiassurance, "but I remember when Mes, Bender made her investments I agreed with her that she was making a clever deal. It is too bad she did not have someone with a wise business head to advise her."

"She should have known enough to make a safe 6% investment, said Harry, as though to dismiss the subject with a few words of wisdom.

"Yes," agreed his wife. "She thought something of that at the time, but 6% on the \$8,000 she had left is only \$40 a month and you can't support a family on that. So she thought in some way she had to make the money go farther."

"Too bad," said Harry, as he got out the cards for a game of solitaire.

But he could not get the subject of life insurance and that inexperienced mother's predicament off his mind. Thinking more of the future possibilities in his own family than of the cards, he overlooked many plays, finally lost interest in the game and gave it up.

"Vi, I can't get Mrs. Bender out of my mind, and for the first time since we were married, I am beginning to wonder what would happen to you and our kiddies if I should die."

"Nonsense, Harry, get such unpleasant thoughts out of your mind. You are perfectly healthy. change the subject.

"No, let's not change the subject," insisted Harry. "Let's be serious.

"You know, I think we have both looked at this matter in the wrong way. We have been pretty careful and are getting along (Continued on page 1)

Copyrigment insulation

How a Big Load Was Lifted from Harry Wilson's Mind

(Continued from page 4)

nicely. Thanks to the building and loan we have over \$4,000 paid on the house, my last deposit gave us over \$900 in the savings bank, we have paid \$3,800 on our 50 shares of preferred stock in the electric light company, Berry has \$300 in the bank, Paul has over \$200 and there's the \$10,000 insurance. That seems like a lot of money. But just wait a minute while I do some figuring."

After Harry had worked with pencil and paper for a few minutes he resumed his discussion. "Here is our picture for the next few years. We must pay \$83.33 on the house every month for six years more. And \$75 a month for the next ten months before we own our public utility stock outright. Taxes and upkeep on the

house are about \$300 a year. "If I should die, you ought to be in position to pay off the mortgage and pay up the stock so you wouldn't have to worry about them. Right now that would take shout \$5,900. What would be left, considering all the money you would have, including even the children's bank accounts?

"\$10,000 insurance, stock worth about \$4,500, savings \$900 and the children's money \$500 make not quite \$16,000. So after paying up the mortgage and the stock, you would have about \$10,000 left. That would bring in \$50 a month at 6%. Right off the bat \$25 of it would be eaten up by taxes and house repairs. That leaves only \$25 for food, clothes, coal, educating the children and other necessary expenses.

"Gee, Vi, you'd be as bad off as

Mrs. Bender, "said Harry.

"Oh, we'd get along some way, but nothing like that is going to happen," Vi tried to reassure Harry.

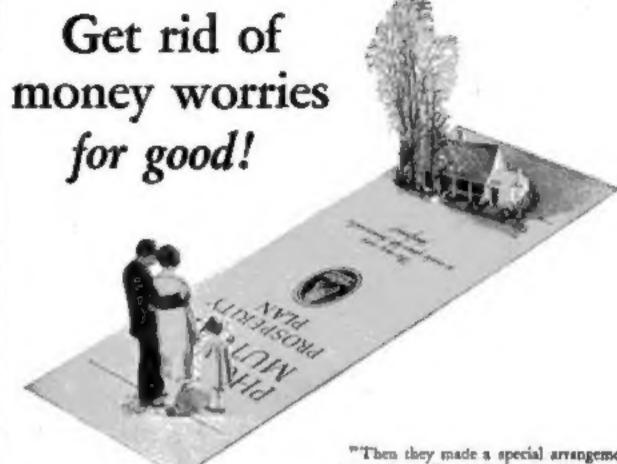
"I am just as hopeful as you are, Vi, about the future, but just the same it would take a load off my mind to know that you were better provided for in case of the unexpected. And so," said Harry with credible determination, "I am going to get this fixed up right away.

"In fact, I guess I'll go over now and see Bob Collins myself. He is in

the insurance business.

"I'll get him to help work out the right program for us. And I'll send Nan over here to keep you company as I probably won't get back until we have thrashed out all the pros and cons." . . .

It was a long session that Wilson and Collins had together that evening, and one thoroughly (Continued on Sugar 4)



Pawo man were talking in a club-house tending room.

"Everything's going pretty well with me -eew," said one of them. "I make enough money to pay the bills, enough even to take a vacation now and then. But I sometimes wonder how it would be if anything happened tome. I know perfectly well the house might be sold, my son taken out of school ...

The other man smiled.

"That's just the way I was fixed," he said. "And then a funny thing happened. I answered an advertisement and got hold of a copy of the Phoenix Mutual 'Prosperity Plan. Maybe you've heard of it.

"I was paying 6 % interest on our mortgagest the time. The Phoenix people showed me how by paying only shout 134% more I could fix

I filled it out.

it so the bank would hand the home over to my wife clear of debt. That was the end of that worry.

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How a Big Load Was Lifted from Harry Wilson's Mind

(Continued from page 5)

worthwhile. People sometimes regard their financial affairs as private. They don't like to talk about them to others. Perhaps it is because we like to make believe that we are better off than we really are. But they called a spade a spade that night discussing the facts just as they were and the result was a very sound and sensible insurance program for Harry Collins. In outline form it was as follows:

Immediate obligations in event of Wilson's death!

Sickness, burial and other Retirement of mortgage estimated)..... 5,000 Balance due on securities being purchased Immediate cash outlay .. \$8,250 (Continued on page 7)

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The House Behind the Bonds reminds the investor of the importance, not only of studying the investment, but of checking up the banker who offers it. Address: Fidelity Bood & Mortgage Co., 1188 New York Life Building, Chicago, Ill.

Behind the Scenes Where Bonds Are Made tells how you can retire in fifteen years and have an income equal to your present living budget. This booklet can be secured by writing to Cochras and McCher Company, 46 North Dearborn Street, Chicago, Ill.

How to Get the Things You Want tells how you can use insurance as an active part of your program for getting ahead inancially. Phoenix Mutual Life Insurance Company, 328 Elm Street, Hartford, Conn., will send you this booklet on request.

Thirty-two page illustrated booklet, describing one of the largest public utility companies, of interest to investors. Utility Securities Company, 130 5. La Saile St., Chi-

The Common-Sense Test of Investment Trusts suggests an easy method by which you may correctly judge the worth of any investment trust before porting your money into it. United States Fiscal Corporation, 50 Broadway, New York, will send a free copy if you request Circular CS.

The Making of a Good Investment tells how 614% can be made on investment in First Mortgage Bonds in units of \$50, \$100, \$250, \$500 and \$2000; how the bonds are protected and how simple it is to purchase them. For a copy of this booklet address United States Mortgage Bond Company, Limited Detroit, Michigan.



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How a Big Load Was Lifted from Harry Wilson's Mind

(Continued from page 6)

To meet this outlay and provide something extra, Wilson's present \$10,000 policy was reserved, to be paid in one sum. It was planned to invest whatever remained (\$1,000 to \$1,750 or more) in high-grade bonds as a sort of permanent emergency fund.

Estimated minimum monthly income needed by Mrs. Wilson to get along as a widow.....

Average monthly dividends on public utility stock... 2.5 Interest on savings bank balance.... Income from invested balance of original insurance policy..... Balance of monthly income to be provided by new insurance..... 140 Total monthly income from insurance and investments.,.,.,... \$2.75

New insurance was taken on the "monthly income" plan which provided that \$240 would be paid to Mrs. Wilson each month for 20 years (or to the children in the event of her death within that time).

In the event of Mr. Wilson surviving for 25 years, at which time he would be 60 and his children probably self-supporting, the cash surrender value of his insurance would purchase a life annuity for himself and Mrs. Wilson of about \$1,400.

Instead of one large policy, several smaller ones were taken out with premiums evenly distributed through the year. The average monthly deposit after the first year was \$75.

This premium item is not an expense to the Wilsons, but an investment, because, if the insured lives he and his wife will in later years enjoy an independent income from insurance.

The two most important features of the Wilson insurance program were (1) that he provided adequately for his family, and (2) after providing for immediate expenses he arranged for the insurance money to be paid as menthly income.

The figures used in this outline are approximate and necessarily general. Each case calls for its own figures and plans.

POPULAR SCIENCE MONTHLY recommends that you regard your insurance representative as a professional adviser. Let him help you work our your individual problem. More and more insurance is being taken out on this basis. And it pays,

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Illustrated above is the proposed engineering group at New York University.. The hailding on the right is already erected and it is here that the tests of the Papalar Science Incritaty are conducted

Deciding What Tools Are Good

I IS a fine tool; it represents good value; it will give you satisfactory service,"—this is what the Popular Science Institute of Standards' insignia of approval tells you when you see it on a tool advertisement. Such statements mean much or little according to what lies in back of them and the tool user will rightfully ask, "How do you know

As a matter of fact, the Institute had no easy task determining this and it took considerable time, work and atudy before it was felt to be in a position to speak authoritatively on the subject of tools.

In the first place, while the Popular Science Institute was fortunate in having some very prominent engineering experts on its staff and in having at its disposal the \$350,000 Sage Research Laboratory testing equipment at New York University, it had little to go by in the matter of test methods and still less in the case of standards.

This meant two things. Test methods had to be worked out and in many cases equipment had to be specially designed for use in making such tests. There are machines like the Rockwell, Brinell and Scieroscope, for instance, that can be used in testing the hardness of the steel in a tool, but when it comes to putting a hammer through a test of so many thousand blows there is no machine that one can go out and purchase for the purpose. So, in a case like this, the Institute's testing experts had to devise an arrangement that would accurately serve, just as it

F. G. PRYOR, Secretary Popular Science Institute of Standards

was necessary to rig out an ingenious reciprocating machine that would put an automatic or spiral screw driver through the equivalent of several years of heavy everyday usage in only a few days' time.

Then, an even harder task confronted the Popular Science Institute of Standards when it came to gaging the test results and determining where to draw the line in the matter of approvals. The Institute's testing experts relied upon whatever could be found in Government bureaus and elsewhere, but the difficulty lay in the fact that they were not trying to set

up any absolute standard that every tool or product must attain in order to be a good one, but were endeavoring to devise tests to suit the use to which each product is put.

The Popular Science Institute's tests are not perfect yet-not by a great deal-but just how far we have gone and just how worth while the work has been can be judged by the recognition that has come from highest sources.

The U. S. Bureau of Standards in Washington has recently appointed the Institute's director, Dean Collins P. Bliss of New York University, as a consulting mechanical engineer for their organization, and the belief has been expressed by officials of the Federal Specifications Board that the affiliation of the U. S. Bureau of Standards and the Popular Science Institute of Standards will result in mutual help and benefit.

Our Assistant Director in charge of tool testing is Major Carlos deZafra, Chief of the Testing Laboratory Section of the New York Ordnance District. This appointment means that all tools of the U. S. Army will be tested, prior to writing of specifications of purchase, in the Sage Laboratory where the Popular Science Institute's tests are conducted.

These tests are conducted for the benefit of POPULAR SCIENCE MONTHLY readers with no charge nor advertising obligation to manufacturers. A list of approved tools may be had by writing the Popular Science Institute, 150 Fourth Ave., New York, N. Y.

Popular Science Monthly GUARANTEE

The above seal on an advertisement indicates that the products referred to have been approved after test by the Popular Science Institute of Scandards

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This is the Rustendy Enverbilly, the unique "H" hartery that ever-dains no waste spaces we multi-cials between the colles the long-est facting of all Economics.

IN DRY cell "B" batteries made up of cylindrical cells more than onethird of the space is wasted. That's inevitable. No matter how closely you park a group of cylinders. there always will be spaces between them. Usually these spaces are filled in with pitch or other aubstances, to prevent movement of the cells during shipment and breakage of the wires connecting call to cell. Think of it-over a third of the space inside the ordinary battery is filled with inert packing material!

In the Eveready Layerbilt "B" Battery No. 486 there are no waste spaces between the cells and no uscless materials. Instead of cylindrical cells, this extraordinary battery uses flat cells. It is built in layers and assembled under pressure into a solid block. Electrical connection between cell and cell is automatic, by pressure of the entire side of each cell against its neighbor.

The most surprising thing about this construction is that it actually makes the active mate-

> rials more efficient. A given weight of them produces more current. and laste longer, than the same amount when out in the cylindrical cell form. This was the unexpected result of researches into methade of utilizing the hitherto waste spaces. Scientists now know that the flat shape is the most efficient form for the cells in a "B" battery. No wonder the

Minstended in the left is the cylinevical will type of "E" barney construction. Total the sension spoon between the golle.

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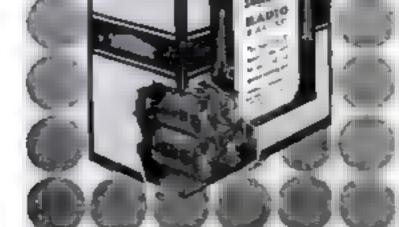
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Our Readers

What Do You Say, Gus?

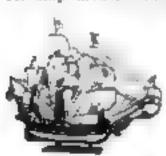
1 S and Joe, Thank Inimitable C garage experts who are with us each month, felt justified, a few issues

ago. is roundly blaming the woman who "drives" from the back seat. Letters from many readers agreed with them. But listen to Mrs. L. S., of Walton, N. Y.

"Why must the wife set in the back seat, anyway? From that position everything looks much more dangerous. Since learning to drive I have found that what looks I ke an unavocable massly from the back seat does not remotely suggest one to the driver, and very rarely to the other occupant of the front seat. This is just a plea for a square deal for the woman."

1 Place of Honor

"PERMIT me to take the opportunity to express my appreciation of Captain McCann's plans and directions for ship model building. Not only are



these plans clear and correct in every detail, but thes produce benutiful and or tintic results. presented a model of the Spanish galleon to a cousin who, among other

gifts, received a new grand piano; and my Spanish galleon now has the place of honor on the piano."-W. C. R., South Pasadena, Calif.

What Hope for Inventors?

"I WAS surprised, recently, to read that Maurice Holland, of the National Research Council, says the independent inventor has seen his best days. Mr. Holland pointed out that less than five percent of the inventions in the Patent Office which receive commercial recognition are the products of men who labor angle handed. And he concluded that the gazzet gennus,' as he calls hum, cannot hope to compete nowadays with the collective work of men in highly organazed industrial research laboratories.

"Is this true? I doubt it. Count over the inventions which have given us most of our modern wonders. The telephone, electric light, automobiles, airplanes. wireless, the machinery of farm and factory -every one sprang from the hand. of a lone worker, often struggling with poverty, but inspired by a great idea.

"Hired workers in great laboratories are necessary for the application of inventions to industry; but the greatest inventsom themselves come from the labors of the garret gena is." Am I right?"- N. B. Y., Detroit, Mich.

The Debate Goes On

"DROHIBITION -Is It Good for l'a?" in our Jenuary essue drew many letters from readers. For example, A. S., of Dwight, North Dakota, weiter

"I have in a most unbiased manner compared and ana-

lyzed the indictment of prohibition by Dr. Charles A. L. Reed, and the defense by Dy Haven Emerson. Dr Emerson. brought forth twenty nine major regions why probbletion is a benefit to our nation. For each reason he offered minnipenchable evidence. Dr Reed, on the other hand, fased to make a point,"

And then Dr. Reed wins the debate by long odds," observes S. M. T., of Cleveland, Olno. "Dr. Emerson uses the errenmatantial evidence of general mortality rates to show that probibition is good for us. His whole argument falls before the undisputed direct evidence of increment deaths from posionous probibition liquie. And does he realize how many people are dying for a good draph?"

What Do You Think?

T OBJECT to fiction in your magazine. Leave fiction to others. Some of your articles seem to be pretty good fiction, anyway."-R. T., Lincoln, Neh.

"The stories are interesting, matructive, and make the magazine more enpoyable than ever."-L. A. T. Peoria, Ill.

"Let's have more stones of the 'Bare Hands type P C K. Manneapolis,

Port tan Science is not quite so popider at usir home with the boys since you have introduced so much reading matter



land. O hour tiles of fiction science so excellent, and

should prove immensely popular with the reading public."-C. E. R., Toronto,

"When there is so much had fiction on the market, why do you have to add to it?"-- S. M. T., Fargo, N. D.

"Your story, 'Midge', tells enough about the making of steel so that it holds a person's interest better than many articles could."-H. R., Edgerton, Wis.

Glad You Like It

HAVE a free muson ticket to the opera, and I go every week

"I have a clock which I never need to wind, yet it strikes the correct time every day in the year

'I follow all the ball games and boxing matches free without crasting the gate, "I go to church every Sunday and

never drop a dime into the plate. Every so often the President of the United States tells are his troubles

In fact, I am quite a privileged citizen. And all because I built that POPULAR SCIENCE five-tube radio. I must say it has exceeded my fondest kopes."-J. L. M., Pittsburgh, Pa.

Apes and Ostriches

AM not a Darwin ape; neither are I my friends." writes C. H. of Los Augeles, Cable, one of the readers who commented on Sir Arthur Keith a recent SHIBBIARY IN POPULAR SCIENCE MONTHLY of the proofs of Darwinup theory. In the same mail S. L. T. wrote from Nashville. Tenn.

"Though I live in a state which has a



law against the teachmg of evolution, the rienz explanation of the evidences for evolution cortained in your article was convincing enough for me. As Dr. A. A. Noves, president of the American Association for the Advancement of

Science, and recently. Evolution can only be doubted by an individual who, like an ostrich, buries his head in the sand out of dread that he may see something shocking."

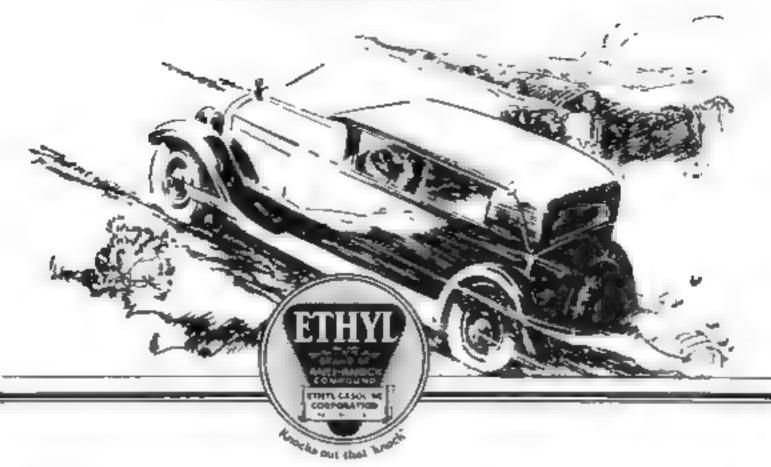
Not Dead 1 et

"THE other day Glenn Frank, the A noted advantor, expressed the fear that modern acience, while creating wonders, is fulling our espacity for wonder and curionity-in other words, making the universe all matter-of fact.

He never saw my kids and me reading our copy of Popular Science MONTREY together. Those pictures and stories of the mysterions far-away stars, of great deeds and adventures, of grant huildings and machines, of the magic of electricity and flying machines—all make POPULAR SCHENCE a wonder book that never grows old.

"As for currouty-well, I'm here to state that the editor of an encyclopedia would faint away if he had to answer all the questions they ask me in one sitting."

M. J. L. St. Louis, Mo.



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Мааси, 1918

SUMNER N. BLOSSOM Editor

VOL. 111, NO.



Making Submarines Safe

Inventions That Might Have Prevented the Tragic Loss of the Crew of the S-4 That Fought for Life at the Bottom of the Sea

By JOHN WALKER HARRINGTON

N A gale-swept bay of the New England coast one of the greatest rescue fleets ever mobilized closed about the spot where forty men had been buried in a crushed coffin of steel, flung to the bottom of the sea.

The living tomb was the mismarine 8-4, one of the largest of Unrie Sam s undersen fighting machines, which had been runned and suck by the U. S.

destroyer Paulding.

A sensitive listening instrument on the S-4's sister slup, the S-8, caught the sound of sharp rapping on the metal bull of the stricken slop. The 8-8 answered and then the rescue ship Falcon with its oscillator took up communication.

The rapping spelled a message in Morse International telegraph cose—a pitiful question from six of the men trapped at the bottom of the sea

"How long will you be now?"

THE question found no answer; it remains unanswered. Yet from out of the depths where those six brave men perished may yet come a response in new ways for the deliverance of sailors who in the future may face the perils of the

The 8-4 disaster off Provincetown. Mass., a few weeks ago, following as it did upon similar neceleuts to submarines, brought to the nation the sharp reminder that although measures to prevent such horrors had been proposed, none had been adopted. This newest catastrophe aroused the American public and its officials to give heed to that query, "How long will you be?" and to demand that the lives of submarine crews be safeguarded in days of peace.

VESSEL of one thousand tons, the A 5-3 was so near like the S-51 which met a similar fate in 1925, that she might well be called a sister ship. She had been at the Portsmouth Navy Yard, and after slight repairs had been sent on a testing crume before being overhanded. She was rising from a dive when the U. S. S. Paulding, one of the swiftest vessels in the world, came cutting the wintry sea at eighteen knots, a little more than half speed. Suddenly the beliasman of the destroyer caught aight of a slender object, the submarine's periscope emerging. A stake of fishermen's nets, he thought.

He changed has course, rang for full speed ahead, thinking only to keep the propellers of the Paulding from being louled by the obstacle. Too late! The conning tower of the 8-4 lifted in sight.



Duoy marking epot where \$4 each and enter ship, the S-8 signations with her oscillating device to doomed over. Above The lost reases

The Poulding struck—a blow so terrific that her own bow rose high out of the water-crumpling the tower like a shell and tearing a gaping hole in the starhoard side of the submarine's battery room. Almost instantly the 8-4 filled and went down by the head into the gray come of the Atlantic floor.

JI ST what happened aboard the doomed vessel during those few desperate moments none will ever know. But from the record of code messages exchanged between the rescuers and the doomed men it is not hard to imagine the scene. A seaman in the tower, gazing through glased portholes to report the first glimpse of green nurface, is killed outright at the codasise of his sentry box. The waters, pouring through the gaping wound in the vessel's side, roar into the battery room. Brine-flooded cells of the storage batteries

send forth stifling chlorine fames. Swirling torrents sweep into the control room—the brains of the ship just under the coming tower—overwhelming seamen at their stations before wheel and valve.

I few struggling men seek refuge in the stern or in the motor compartment wading wait high in the flood in a vain at tempt to close a bulkhead door. Six men, a lieutenant, three torpedo men and two seamen, gain the forward torpedo room, and are safe, for a time, in this steel-girt prison cell—a hubble of air twenty-three

by heavy ac

Central control enom of the 3 d. Anuma these astroments an ironic symbol of the power of man over the forces of nature—some of the men of the automarine perished with many would-be rescuers close by

feet long, ten wide and seven high

What thoughts come first to the minds of these sur? Not much an a landsman might think, for these are rien whose every day is a basised. The fate of the 8-17 flashes before them. One charge in a thousand to be saved! But they are fighters all, and they will fight to the end for that chance

Now the nerves of the S is cease to thesh. Her lights fade. Her heart is stated Heat thes away and the narrow chamber grows as cold at the water that presses

ngamst its walla. With blankets taken from the shelflike beds, the shivering men fight off the tomblike chill. Scant emergency rations are doled out. Water seeps in, covering the floor of their black prison. The air they breathe grown state and will soon be posson, but they pin their hope on five small steel cylinders of condensed oxygen to keep life in their bodies until aid comes from they know not where. Saving their energy, they breathe as lightly as they can—and wait through hours that seem days. In their monds—for speech wastes breath—they turn over and over again the chances of coming out alive.

MEANWHILE the world above is alive with activity. The Poulding, having thrown a buoy to mark the place where the submarine went down, and having sent lifeboats to search—vainly—for survivors, has imped to Province-town to report the collision. Telephone

and telegraph spread the news to Washnigton, to the Navy yards, to the submarine base at New London, Coun. Salvage experts in New York, Boston, Norfolk, hurry by fast trains, by automobiles, even by hydroplane. Crack divers, eager volunteers, hurry to the scene.

BUT how slowly come the salvage vessels. What ages the hours have seemed to the an expures in the torpedo room, while twenty-six vessels, battered by heavy seas, can do nothing to bring

them hope!

I wenty four hours pass. I diver descends from the rescue ship Foleon to the broken wreck, 101 feet below the surface. He is Tom Eadie, swathed three times in wood under his waterproof diving out. To him comes a faint sound Is it only the echo of him own leaden tread, or does it come from the shattered hilk? Whirling a hammer, he strikes the steel shell a resounding blow. There



Engine room of doomed 5.4. Here others of the submarane's officers and crew were trapped hopelessly when the creak so machinery could result sent but to the bottom

rap. He telephones from his copper believe to the Falcon:

There is life aboard."
Then the Folom above, using an oscillator for communication, begins an exchange of tapping messages in Morse code—a quick tap for a dot, two

taps for a dash.
Is there any gas?"

"No," is the steady answer, "but the air is had. How long will you be now?"

How many are there?"

There are see. Please burry! Will you raise us soon?"

'Everything possible is being done," in the reply

"Good God" we can hear them say
"Everything possible! Is anything pos-

sible? Have we a chance?" They think of the S-51, cut down by the S. S. City of Rome off Block Island in 1925 and raised with her thirty-three dead nine months later. American submersibles have no outside fastenings to provide holds for lifting chains or cables. The only method possible now, as with the S-51, is lifting by pontoons. Divers with air guns must blow tunnels under the holk. At this writing none had been able to do that in the silt of Provincetown, although three had nearly died in the attempt. Once tunnels are made, chama are passed through and attached to poutoous which can lift the wreck-a long and technus process at best,

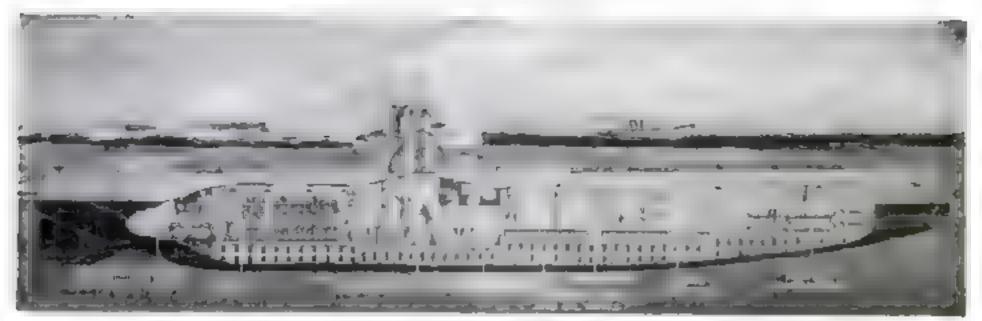
SCIENCE has done much to provide the means of life for the crews of sunker submarines, yet that much is far from enough. Their own resources crippled, the trapped men had only the five bottles of oxygen to keep them alive bottles of oxygen to keep them alive butil the promise of rescue was made good. The last bottle gave out on the third day, as they tapped in one of the last piteous pleas for help. Then the tapping signals grew fainter, and finally ceased. They had penshed.

The tragedy brought a floors of criticisms of the Navy Department for failing to provide better means of rescue. Even the hurshest critics, however have praised the officers and men who mode every effort within their power for the doomed men. Coundering the limsted facilities at his disposal. it was generally conceded that Rear Admiral Frank H. Brumby us charge of the rescue fleet did his tituiost. Certainly Lieutenant Communder Edsberg, now retired from the Navy the sulvage expert who directed the raising of the S-51 and who,



View of all end of the S-Fs torpedo room, showing the four tarpedo tubes in the middle of the photograph. From these quarters six of the crew signalled for 3 days that they still lived

volunteering his services anew, nearly lost has life in diving about the wreck, is deserving only of honor. The heroism of the divers seemed superhuman. Among those who think so is 1. S. Representative Anthony J. Griffin of New York, who introduced a resolution asking for a Congressional inquiry of the whole



A longitudinal verticual drawing of the S-I submerged us that only the coming tower, perincope and part of the exterior regumn three above the surface. The artist has shown all the enterior uncluding the toropide compartment, where life was last known to exist

subject of safety for submarine crews with special reference to the loss of the 8-4. He moved in vain for a similar inquery when the 8-4 was sunk.

Representative Griffin is an engineer and has invented several submarine safety appliances, which he has offered to the trovernment. He and others have proposed that evelets by which the vessels may be lifted be attached to all submartnes. By fastening such rings to hands welded to the holls Mr. Griffin believes they would be entirely practicable.

Mr. Griffin also is the inventor of a life raft or chamber designed to it into the superstructure of a submarine between the deck and the hull. In case of accident the crew could enter that chamber from below through a hatch and set it free by releasing a pinco. The device, containing air cells, would be buoyant enough to rose to the surface.

Some of the newer types of submarmers have air locks connected with the coming towers, from which the men can emerge when the vessel is badly impired. I note some could home torpedo tubes may serve as emergency exits. Owing to heavy pressure of water at such a depth as that to which the 5-4 same, the crows in such escapes would need strong behaves and

protection for their chests. For such purposes light diving such, fitted with small oxygen reservoirs and air purifying devices, are in use in the German. Dutch Damsh. Swedish and Spanish navies.

N INGENIOUS es-A cape compartment designed by Storon Lake. precise of subaggrans, mas proved practicable. Men who are about to leave the vessel first enter this room into which several atmospheres of compressed ar are forced. When the proper quantity has been injected a hatch cover m the bottom can be opened and the sea water, rising only a little in the well, is kept in check by the pressure of the air, allowing escape through the batch. Since help boost be prompt, a signal buoy, which can be released from its bousing on the deck of a sunken submirine and remains anchored to the distressed vessel is standard equipment in several navies. In addition, a telephone wire running from an instrument in the floating buoy to the interior of the submirine provides ready communication.

BETTER methods of connecting air boss to a disabled subminizate are demanded. Instead of only one inlet, leading to the interior air system of the vessel, an inlet for each compartment has been urged. Not only could fresh air be pumped in through these, but coffee and liquid foods.

The undersea tragedies of the last few years have shown that the American Navy does not own salvage vessels and pontoons large enough for spendy rescue of large submarines. In the terman and Itahan mayies are super-salvage vessels ready to go where the government requires them. A German salvage ship, the Union, which raised the Union that had no 1911, can lift the largest types of submarines with ease. She commits of two holls, which are really huge pontoons that can be lowered or raised by ad-

mitting or releasing water hallast, as does a submersible. The sections are joined together by a heavy steel bridge on which powerful cranes are mounted.

IT IS estimated that effective salvage vessels of this type could be built in the United States for \$1,300,000 each. Even at a higher figure, their time would seem to be justified, for large submarines cost about \$3,000,000 apiece, and carry gailant men.

Representative Griffin has suggested that many of the Shipping Board vessels, now moored in out-of-way places, might well be converted into savinge outfits similar to the I seem by joining two of them entameran fashion. Adequate equipment of all kinds should be built and ready to respond when the need arises, not made "to order

HOW little prepared the Government has been for such disasters was illustrated in the now almost forgotten loss of the submarine F-4 near Honolulu. Since no savage vessel was available, one was made up from two scows and a crane, requiring three weeks labor. Then it failed. So expert divers were summoned from the Brooklyn Navy Yard. 2000 miles away and pontoo is were

built in San Francisco and shipped on a crusec. The F-5 was rused at last—with the bodies of its crew of twenty one.

Definite action toward greater infety now seems pretty well assured. In addition to the formal Navy Board of logury, and a Congressimal investigation into the S & disaster. Secretary of the Navy Wilbur has announced be will ask a commission composed of both haval officers and commission study the situation.

Possibly never before have the American people become to aroused over a naval disaster. If the lesson serves to safeguard the lives of middles of the undersea in the future, the galant crew of the S-4 will not have perished in vair.



Diver Wickwire, being lowered from the reacus ship Falcon in one of the efforts to pierce the shell of the S-4 in such a way so to carry life-saving air to ber valuant even without admirting at the same time suctor that would instantly cause their deaths



Col. P. H. Fawcett, of whose party nothing has been heard since he and his son and a friend entered Brucilian jungle three years ago

UYABA, Brazil. Freed from romanite explicitly as the living idol of a remote Indian tribe hitherto unknown to resence, Col. P. H. Fawcett, the noted British explorer who in 1925 vanished into the jungles of Matte Grosso, is now being brought out to errobeation.

"Messages from Commander Dyott, leader of the Fawcett relief expedition. malicate the rescue was accomplished by a clever raid upon the savages' village in which amplane and oversand party cooperated.

WITHIN the pext eighteen months I expect to read a news desputch worded much as above. It will mark the climax of an adventure rivaling the most sensational exploring feat of the last half century.

In 1871, the world waited breathless while Henry M. Stanley fought his way hundreds of males through equatorial Africa to rescue the long lost Scottish mismonary, Dr. David Livingstone.

Is Lost Explorer Now Jungle God?

 B_V FRANCIS GOW SMITH

Today, Commander George M. Dyott, explorer and lecturer, has set forth on an even more during mission. To wring from the jungles of Brazil some chie to the mysterious fate of the vanished British war veteran, Lieut. Col. P. H. Fawcett, D. S. O.

Mer a life dedicated chiefly to South American exploration-as Livingstone's was dedicated to discoveries in Mrica-Col. Fawcett undertook, three years ago, to survey and map the leastknown fastnesses of Matte Group. At the age of fifty eight, accompanied only by his son Jack and one other white compamon, he plunged northward from Cuyaha into the wilderness-and he has not been heard of mines except through romantic rumors that only increase the mystery of his disappearance.

MMMANDER DYOTT is a fellow C Englishman who has already made two speciacular trips through the heart of South America -one over the Andea from the Pacific and down the Amazon, the other last year along Roosevelt's trail and down the River of Doubt. But this time Commander Dyott, financed as Stanley was by American capital, must penetrate a gloomy wilderness more forbudding than he has formerly traversed. and even less known than Africa was when it awallowed up Lavingstone; and Dyott in Brazil will have no such clues as helped Stanley on his historic quest.

The name of Henry M. Stanley fifty years ago was a synonym for daring edventure. After explosts on both sides in the Civil War, he was commissioned by

James Gordon Bennett of the New York Hreald to find Dr Livingstone, who in 1863 had set out to discover the longsought sources of the Nile and for nearly seven years had not been heard of,

Stanley, leading 200 men inland from Zanathar through the densest of African jungles, soon began to get word from the natives of a strange, bearded white man lying ill and belpless at the slave-trading town of Lain, on Lake Tanganyika. And there, on November 10, 18"1, Stanley, exhausted by his eight months of hardslep, had no words to greet the venerable mistismary but these, 'Dr. Livingstone, I presume? which still celo in the pages of history,

But Commander Dvott is faced by the apparently insurmountable task of locating three so there exists somewhere in \$50,000 square unles of trackless jungle which Col. haverett called the last great blind spot on the biortable globe. It is greater in extent than the combined states of Ohio, Illinois, Indana, Iowa, Missouri and Michigan. Native frontiers. men fear to cross sta fringes, beyond which roam perhaps half a million naked halmas, some of whom have pever outgrown the stone age.

IT IS true that Col. Fawcett has been I for years at home in just such country A British artiflery officer who served during his youth in Ceylon, Malta, Cluna and Morocco, he was lent by his government in 1006 to Bolivia to act as considery commissioner. Having herped clear up the disputed line between Bolivia and Peru, he gave himself up to Brazilian



FAMOUS authority on Brazil offers here an amazing explanation of the mysterious disappearance of Col. Fawcett, British adventurer, who is now being sought by rescuers in the South American wilderness

exploration until the World War, in which he brilliantly commanded a brigade of field artificry

In 1925, backed by American newspapers and the British Royal Geographical Society, he plunged on his present senture with only his son Jack and one friend, Raleigh Rimmell, to accounpany loon

BESIDES mapprograknown terratories in the neighborhood of the Paranatings and Topolos

Rivers, ha plan was to seek the remains of an arcelet civilization, antedating Egypt a. But Brazi into in Matto Grosso who were among the last to discuss his plans with him tell me and I believe that the Consiel's real intention was to discover the fabiliously rich lost Gold Mine of the Martyrs, unworked for two reactures since its early Portuguese discoverers were murdered by their Indian slaves—which is supposed to be somewhere north of the River of Death, between the Xinga and the Araguays.

NOW in the late spring of 1925 Colonel Fawcett sent back by messenger his last report, and it showed bing veering toward that region. In a month's arduous teavel northward from Coyaba, he had reached the domain of the Bakarri Indians. His two native camaratas, dreading the savages ahead, were about to leave him. Ruleigh R mined was infected from an insect sting and the pack



Where Fascett and his narry vanished. his possible edventures are perturble in the accompanying article by an expert who has penetrated the wildersom

tran of fourteen unruly animals was causing luftuite trouble.

three years of otter sience And as Commander Dyott acts out, the question arises whether tol. Fawcett in still slive.

A French engager,
Ruger Courteville,
was reported to have
found Fawcett living
an a hermit in a
pungle paradise a
bundred index from
Cuyaba, but thus report has been thor-

Another English explorer, Captain Alfred Henry Morris, later visited the same territory building Fawcett, and found not a trace of him.

FROM my own practical experience to the region I have reached certain conclusions as to his fate

I behave Col. Favorett in still abve, and when I say that he is today probably the captive tribal divinity of a band of sayages. I am supported not only by my own experiences but by instorical as I ethnological data and by the options of Brazulan feorgessnen with whom I talked less than a year ago.

Mrs. Fawertt the Coronel's wife, who has been hiving at St. Malo, France, says telepathic messages from him convince for he is alive and she has said.

"I believe my husband is the presoner of some tribe of Indians who are treating him well because of their superstitious awe of law powers. Curiously, Com-

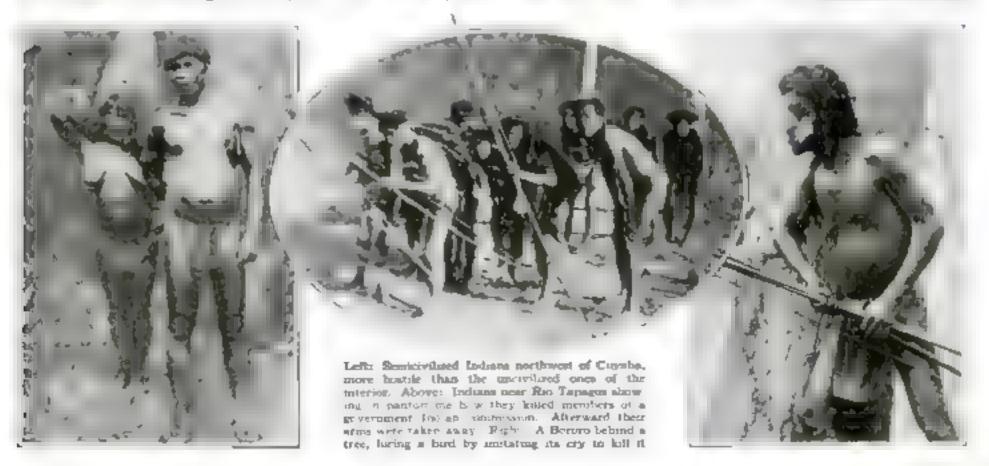


Commander George M. Dyott himself an experienced explorer of Brazil, who is setting out into the wilderness to And his less fellow explorer and compatriot, Col. F. H. Fawrett

mander Dyott's own experiences have been similar. He was once mining for months—all that time being kept prisoner by Indiana, Col. Fawcett will yet bufound.

From Col. Fawcett's last letters the Royal Geographical Society as experta deduce that the explorer had altered his originally announced plant and, having reached the Rio São Manoel, tributary of the Tapajos, was away ag northeastward. It seems certain that he had hit on the plan of traveling overtant, south of the tenth parallel, as ag a route that would have brought lum to the Araganya River. And this route would take him directly through the traditional region of the Martyri' Gold Mine.

NOW had Colonel Fawcett continued northward toward the Viazon hetween the Xingu and Tapajos B vers, he would have run into the hands of the Mundarucus, who are industrious head-hunters. Or, and he sought to avoid them by descending a toward on page 1-9.





What Happened When the Big Air Liner Took Its First Trip A Story of Ingenuity, Parachutes - and a Girl

JUST ment on all metal arresaft construction and volumes sure to start some sort of argument. But ask for the best all metal print in the game, and the fiving world points for out. Jack Page. This variables to do with an all metal combination. Jack, and his all metal arrives the Pacific Gulf.

The three-engined ten passenger fiving eraser the Pacific Gult—was the first mult motored superplane to attempt sensitive to ply the air as a common carrier between Los Angeles and San Francisco. But the Pacific Gult's career was hirel, epic and brave. Lake so many other pioneering tries, the log of the Gult goes unuing, and unremembered save by a possible ten. The ten passengers and two others—Pilot Jack Page and his worthy flying mechanic, "Cheese" Farling.

Pilot Jack Page was the owner, designer and builder of the great craft, which was Jack a oldest and best dream come true More than a year's hard work had gone into the construction Jack. Cheese and half a dozen others had done the sweating How Jack promoted the cash—she cost upward of sixty thousand dollars—no one knows. But, from here and there, the money came; and the plane had taken shape. Great shape, too.

Every trust that went into the Golf was band-picked and tested by Jack. Every vard of dural was the best. All bittings were hand-sawed from cold rolled stock, among reinforced and A I pieces of workmarship. Jack Page squeezed the old brain dry trying to make thougs right. That was Jack every time air-mized and air wise in the exacting things of newnys. He was big in every way possible big in the boots from which he towered, and big in his handing of a tough game—air

So he gave something worthy to the air when he trundled the Parific field out for its first hop. And the aeronautical world reassed that Jack and coworkers had sounded a new note in aviation. The job was good

The big craft was of orthodox hiplane design. It had a wing spread of eighty-five feet, the top of the upper plane was about two stories aloft, and its overall length would make the average big plane appear stubbed. The ten-place, glassed-in calon was hizuriously appointed and entirely protected the voyagers from any contact with the elements. Belund and above, side by side

and in the open, were the pilot's and flying mechanic's seats, for pavelsological effect, Jack Page had arranged this cockpit's segregation of the passengers were unable to watch the pilot, in the event of auxious moments they—the passengers—would never guess that auxiling was arms. A stepdown and short gaugeway connected this rest control pit with the main salron

Each of the ten seats of this fuselage ca on was booth the pretty much after the design of a Ferris wheel's caged cars. To become seated, the passenger stepped down from a narrow cut walk which centered the compactment. The brief dropoll made one feel that the legs were hanging through the floor, and maybe they were. When in the seat, the inde contions came just about shoulder-high. Comfortable, that's what it was,

This new seating afea was one of many other important innovations. But Jack Page always short on talk, allowed them to go unmentioned. And it was these transentioned thougs surprise parts—that, as was noted before, the ten possengers will never forget. No, never! Yet—and make note—Page never "lost" a force.

THE powering of the great Pacific feell was unique in that two types of motors were used. On each lower wing, at the first interplant struts, was a power nacelle hiding a cowled in Wright engine of one hundred and eighty homepower. These two motors were worked as "pushers," that is, with the propeler behind the trading-edge of the wing. The third power unit, the central motor in the nose of the fuselage, was a Liberty "12" of four hundred and fifty horsepower. In all, the Gull had upward of eight hundred measures of that much-denied stuff—horsepower.

The hig Laberty engine was solidly bedded on a four-pronged tubular carrier that was firmly bolted—each of the four prongs with a large drift pin—to the fire-shield bulkhead which was the nose of the fuselage. It was a fine mounting. Simply remove two drift wires and drive back four pins and, hooking a block and tackle to the whole works, out came the heavy power unit motor, water radiator, oil tanks and all. From a point of efficient field service you couldn't best it, and Jack Page, saying

little about the installation, took great silent pride in this piece of clean-cut engineering. The mention of this

motor mount is important!

On the morning of the Pacific Gall's first scheduled Los Angeles-San Francuco flight, the first passenger to arrive was plural. It was a man and wife wherein the man was irrelevant. And, at first, you didn't see him; but, on second thought, you knew that all those hand bags weren't carrying themselves.

"Where do we sit?" the lady demanded, and waved two good one-

way tickets.

Cheese Farling—he was doing the scating-waited till be got a good look at the man before making answer "About ninety pounds wringing wet." Cheese apeculated under his breath. "And she," he thought, "does not weigh much more. . . .

"IN THE two rear seats, madam," Cheese said.

"But the front seats," said the lady, "they're empty; why can't we have

them?"

Cheese was just about to mill that old gag, to wit: that both ends of the plane arrive at the same time. But Jack Page, knowing how to hundle women, came to the front and explained that a plup must be loaded in nuch a way as to best favor its longstadinal balance, and maofar as the plane a center of gravity always falls somewhere in the wing boy, there too should the craft's load be carried. In the matter of passenger leadingstubs and thins to the rear; fats and oversized to the front. The lady understood perfectly ' Hut my brothers," she said, "where

are they ?"

"Now there's a hot one" Cheese exclaimed, inwardly, as he hatened. "Where are her brothers?"

"What do you mean, madam"" Jack saked. "Did you expect your

brothers to see you off?"

TO, NO, NO! My brothers are going, too. They bought their Lickets when I got ours."

"There's half on hour yet." Jack informed the agreated one, "and no doubt they'll be on the next bun."

"You'll seat them next to us?"

"Yes, madem." "When do we depart? When will we be in San Francisco? How far is it to Frisco! How long does it take to get there? Will we be there before the steamship Hilo arrives from the Islands? Will we? We must. My suffer and her family are on the Hdn."

"When is the Hilo due?" Jack inquired.

"This afternoon ' the lady told him. "According to the company's Los Angeles office, the *Hilo* was two hundred unles off share at all o'clock this morning. Will you promise to get me to the Hilo? We must be there when she docks, to meet my sister "

"I'll get you to the Hilo," Jack Page promued in perfectly

good faith

Just as this conversation terminated, the two brothers arrived and lined up with the loggage-carrying husband. Cheese stowed all hand baggage in the tail-bay compartment, and marched the three boys into the plane.

The next four passengers came in a body; all men, on duty bent. They were government agents of the Bureau of Agri-

"When do we get into Frisco?" the chief asked.



The plane circled down over the Takio. Already the big liner had sighted the five parachutes and -padging by the white foam along her sides—bad reversed her screws and was standing by

"Take off at eleven," Jack said, "and arrive at three, four

If you make it by three," said the chief, "that will be jake! We've got to be there when the Tokto More makes port. She a loaded with silk, you know, and we've got a big job shead of us a new alk bug has been coming in from the Orient. Another plant pest. The Tokso Mark was three hundred miles off share early this morning, or late last night. She's fast. You're sure we'll get her before quarantine "

"Easy?" Jack cheered.

MORE luggage was packed away in the box behind the pilot's cockpit and the four government men took their seats.

Then the fast two voyagers stepped from a tast: came through the ropes, and dropped their bigs at Cheese's feet. These two, a large man and a small garl small but ob, boy!—were openly

"Just got under the wire, ch, Sis" the big man grinned as he dug up his tickets.

"Bet we did, Dad," the garl answered. "And if we missed

thus, we'd miss the Tokio." See two more running for the

When do we make Frisco" the father asked as Jack forced im through the small door. "You we got to get us there before the Tok to Marie shoves her pose up against The Embarcadera. This little girl's ma and sister are on that Jap boot and they And if you don't get us to them -well, boy, don Lexpect us. your maurance is the best thing you ever did."

"I'll put you right down on her pose," Jack laughed. "You

and the young lady will sit up front

"With the pilot?" the girl exclaimed and enthused

"No." JACK smiled. "On this plane, the pilot rides the

"Hut I we always wanted to ride with the comuser " the girl rented. And, presently, she was moving in the direction of desire. When the American girl wills, she will'

"Sure " the fat old boy said as Cheese and Jack showed him to me tight fitting seat, "let Six ride with the pilot on the tail. Cheese busily readjusted the safety belt which fell several

inches short of circumius/igating the fat one's equator--"What do I want thus belly-band for anyway?" the big man floally asked. "Boys, you re not going to loop this flying hangar, are Yard a "

Just an ordinary precantion. Mr. Dema,"-Jack and markly ratified the name from the tickets which he atill held, and, also, noted that the girls name was Minira Deusa

"Are all these people tensed up too?" Mr. Denne naked and laughingly looked shout. He discovered that they were. "O K , boys, the tne tight' And how about it sean Sacride the tail "

"It a juke with me," "I don't Cheese agreed. need a sont." Almira-Cheese knew-was not the kind to be in anybody's way

"It's settled, Mr. Deass." Jack consented. "I'll show your daughter how it'd done Jack deln't must if size was in the way

"Tannka," Mr. Densa are led - sat you flatter your-

aelf boy. Before you're in the air five minutes, she'll be showing you how it should be done! Then we will need these here formfitting gardes

From passenger to passenger, working aft, Jack and Cheese moved at 4 respected their safety belts. Also they made certain that the nale door of each small booth was firmly closed. Then they were ready to above off and Jack moved back and up to his controls. Cheese went overside to assist the ground crew with the starting of the motors.

NE by one, the orde motors barked into action, then settled down to their warming up pure and with a bang, the lanerty came to life, howled for a moment, then fell to "cuttin em off" as only a well-behaved Laberty can do. A cloud of dust paraded back to the rear, the crowd of spectators gave way, and the Parific (call was a throbbing thing of splended life.

While the motors warmed, Jack called Cheese to the cockpit.

and pointed to his instrument-board compass. "Look at it?" Jack exclaimed. "The darned thing is sure

gyrating like a merry-go-round, ch²¹¹ Cheese watched the dancing compass float. "She's sure baywire, but what can you do "

"Not a thing," Jack resigned. "But it gets my goat! Ove minute your compass is in perfect orientation, and the next minute the motor generators have turned it into a pinwheel. Hold onto everything, I'm going to give these motors a run."

For thirty accords the three motors, at top speed, made the world awful with their combined roor, then, slowly, Jack closed the throttles and the power units fell to a muffled silence once

"Pull the blocks" Cheese yelled, and climbed aboard. The

ground crew removed the wheel chocks, warned back the crowd, the motors sent up their wait again, and the Paryle Gull lifted its tail and was gone.

Getting off the ground. Pilot Jack "poked" his ship a nose at Hollywood and the hills beyond, to the north. The craft made

"A climbing fool?" Cheese shouted from where he was squat ting beside Jack and the girl. "She's what I call a rocket, and nothing che but "

"It looks like heavy going ahead for the rocket." Jack answered and pointed to cloud banks far afront. "Pray a little,

Cheese."

The Parific Gull was in clouds before she had lost sight of Hollywood. And those clouds were getting heaver every manute. They seemed to be heaviest inland, so Jock eased off toward the sea.

"I'll have to work along the coast," Jack yelled. "We'll cut

over Santa Barbaca and keep just west of the ridge

The coast was picked up a little south of Ventues, but the clouds were heavy as ever. Visibility over the Pacific was very poor, and the mountains—now all at their right

> along under the hard going, and, for the time being things were not too bad. Not too bad, but had enough The Pacific Guille first hope wasa t going to be at juy And Jack Page was holding that olup "in his lap" and

alertly custing one bail corr poor that he was going to ared, and need burtly BEYOND Santa Barbara

fell over the (call and sent out shapeless orms of signater omer. Beyond right over her case, the sea fog car ic op. and in that gray green noses three propellers out their wharling disks of white. Below, the sea had also gone out. And Jack Page drew the big ship is little closer to

Now, with all earthly morks gone, Jack flew out or ly by altimeter and instinct He held an altitude of three

hundred feet, tried to visualise the lay of the share, at his rig it and ever and ever gave way to the left. He know that the open sea was better than mountains. Anyway t us fag could not belong. Ram was falling now, perhaps she'd clear

But the thick going did last. One hour payed out, and another. By that time, the Pacific Gull was in a sad physi-Jack Page—without the aid of a compast—was lost. But, when

lost -you fight!

The calm passengers also realized that all was not well. At first. Cheese had tried to tell the back-scat four that the island effect was only smoke from burning rubbish, but he couldn't make it stick. Mr. Deum and the four government men size the tapped the arm rests of their anug booths and stored out the sets. windows.

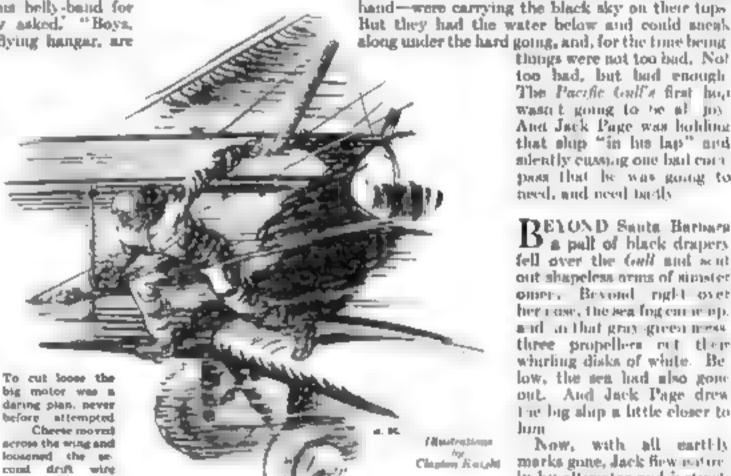
"Everything will be jake" Cheese told them. gasoline enough for three bours more. Long before the end of that time, we'll ride out of this stuff." This was a reasonable

"Yes, but where?" Jack asked humself as he listened to Cheese's voice come up the companionway he asked the girl.

"Do I look it " she smiled back

"No." As he spoke, Jack studied her face. And knew "Well, that a the correct answer, Jack Page. Lend on."

THE Pacific Coast, from Los Angeles through Santa Barbara to Point Pedernales, runs nearly due west for one hundred and fifty miles. But at that point-Point Pedernales the mainland quits its westward push and the shoreline points almost straight north to San Francisco, two hundred and sixty miles away. So, at the end of his second (Continued on page 170)



Why We Are Immune to How Tiny Bodies in Some Diseases

How Tiny Bodies in the Blood Protect Some Men Against Illnesses That Others Cannot Survive

> By LIDDA KAY

OUR men of Buffalo, returning some years ago from a convention in a neighboring city, were strucken with typhoid. The infection was traced to the water they had drunk in the convention city.

Why was a fifth Buffalo man who drauk the same water apparently immune to the one laughts of the typhoid bacteris? And why had all but a few residents of the convention city been able to drink the posson-laden water with impurity for weeks, possibly months?

In the answers he the results of some of

the most important discoveries in the history of medicine, as well as of a scriet of amozing experiments dating from Pastent's most action of hear with old cholers germs. They go factoward explaining why we contract the diseases we do, as well as those matances of apparently maracidous escape.

Two men using a public telephone receive arithments germa deposited there by a previous patron. One develops the discase the other doesn't. Three children in a family come down with measies, the fourth a minimize

Such instances can be multiplied and fiintely. The phenomena of natural inmanity have been observed for centures.
Yet only recently since the estancesment of the bacterial origin of disease.
—have now workable explanations
been offered. The discovery of ways
to make an ortificially immune was
the next step. Some day the doctors
tell as, they will have found vaccines
and serums to immunize us all to all
diseases of bacterial origin. The family doctor of the future will be an

Their theory is thus:

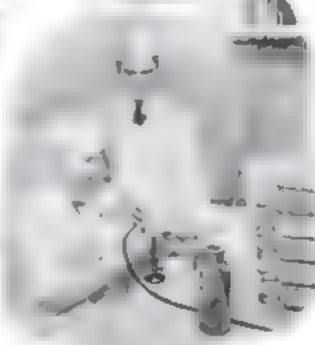
ammunologist.

In our bodies are countless armies of tiny chemical substances called antibodies—our chief front line fighting force against disease. Each antibody has its own particular antigen, or substance for which it has a chemical affinity. Any disease germ is a mantigen for a certain antibody, and if each invading germ finds its particular antibody in our bodies a battle ensues, the antibody destroys the germ, and we ourselves do not even know that we have won a victory.

Your body may at this moment be well







Above Boston school children ready to receive the Schick test for dightheren. If slight to jection of the disease train comes inflammation, one is susceptible, Middle A child receiving injection for test. Below Preparing dightherin totals to test unautity Scarlet fever and smallpot totals also are made to test immunity against these diseases

fortlast will develop must all a maglayers we aftal as a laptic of a large fortest and research a car there are a a factorial and we are used to dedetermine the record with which, three and the rest of speed with which, three an access that it, your body events enough and oad a to stream the applilated con-

The Buffa many arcsenses land suffront to avoid antibodes. Residenced the affected city had apparently and able to develop manually through the growth of authorizes in their bond or a city-sude scale, the water pollubous being probably a very gradual process.

For centuries, of course, mea had presented over two kinds of immonity natural or maste, the other acquired after one had survived a particular disease. Cholera, for example, conferred minimumly for life on han who arrived Curious preventive measures followed these observations. Asother made end dren wear alarts of sufferers from the light form of smallpox, reasoning that the children would also acquire the disease in light form and thereafter be immonic from a possibly fatal attack. The Turks, on the same theory, those lated themselves with pus from mild cases of smallpox.

Then, one day in 1880. Pasteur by accident inoculated several bens with old the era getter make a few ways, whose the end of the usual freedom law has several and the recovered had they were beneeforth mountage.

That was the beginning of laboratory made vaccines. Pasteur had shown, in effect, that when weakened bactera are injected into our bodies, they work no serious harm but cause creation of anti-



How disease antitoxine are prepared. A slight expection of a threase torin, as above, causes the development of anyibodies us the blood of a harm

and or which protect us against virulent meteria of the same species. The innuitarity so conferred is called active immunity, because our own bodies create the protecting antibodies.

A few years later other scientists descovered that the blood of muno used an male, transferred to other an male conferred temporary ammonty to the same duence. That was the beginning of scrom presention and treatment of disease. The manner that conferred is called passes, because the antibodies continued in such blood or seram are transferred ready made into our bodies.

BRAVE men have rescent these last forty years, in the search for new vaccines and sew serious—for always some human being had to be the first on whom the new preventive was tried. When Jack kabbe, a private in the Army was bonorably discharged from the service recently at was revealed that Rabbe, with a few other American sofdiers in the Philippines, side in test voluntarily to insect lation with the gerias of dengue fever. Doctors atomed the progress of the disease among the intents, with a result that the fever rate a nong America i troops was reduced from eighty per thousand to twenty

When a squad of American Army collisted men who had volunteered to risk their lives in a similar way were told that provising had been made to compensate them, they joined in refusing to go on if they were to be paul. In one of the most dramatic military scenes away from a nattlefield the high officer to whom they gave their ultimatum rose and bowed and lifted his hand.

"Gentlemen 'he sand, "I salate von '
You will be glad to know they survived,
Recently a Philadelphia doctor anbounced a serum treatment for rheumatum, which is not due to old age, but in as
much an infection as measles. The jun-

portance of the announcement her in the fact that heart disease causes more deaths than any other maindy; and rheumatism, according to Dr. Henry Albert, commissioner of health of Iowa, causes from fifteen to twenty-five percent of beart disease

MORE lately two Denver physicians, Roy P. Forbes and Berryman Green, demonstrated that a child with measles can, by giving a few drops of his annune blood, protect his younger brothers and asters from the choeses. When the patient's fever begins to decline the blood is taken. Serum made from it produces a very mild form of mod-



Blood of the inocolated horse is later drawn potelersly, and the series is extracted and administered to human brings, either to confer immunity against (lines or as a treatment

fied meader in the children who have been exposed to the disease, and so confers minutely without making them ill.

Today man can make himself immune, by vaccines or scrums, to typhoid, small pox, tables, diphtheria (temporarily or permanently, depending on whether anti-toxid or loxin-autitoxid treatment is used), dysentery, plague, cholera, lock-jaw (temporarily), scarlet fever and measies (temporarily).

I NFLI ENZA, infantile paralysis, pneumonia and tuberculosis are diseases against which immunication is still being sought by laboratory workers.

Yet we have only just begun to combat infections. We treat symptoms instead of treating root causes and effects. Frankly, we are ignorant to a large degree of the chemical constitution of living matter.

If the time and energy and ability that have been spent on metallurgy were spent on metallurgy were spent on medicine we could manufacture anti-toxin as readily as we can make cobalt steel. There has a great field for the chemist who will turn his attention from dyes to biochemistry.

With the accomplation of new data on minimity, other questions rose. Are immunity and suscept full ty hereditary? If no incident of your family ever had the measles, can you assume that your children are safe?

"No, you can't inherit permanent imusuanty to infectious diseases," one doctor puts it, "any more than you can inherit susceptibility. Children nequire tuberen losis and other infectious diseases from parents only as a result of close contact with them. The same goes for immunity."

Dr. 1. W. Famulener, well-known immunologist of New York City, told me that city people develop a marked's greater degree of momenty and resistance to discuss than their apparently healthier country consins.

"The explanation," he said, "is that constant exposure to disease germs i crises over a period of years standates the gradual production of antibodies. You know that the injection of gradually is

creasing doses of dipliherus toxin into a home will eventually toake him immune to a dose that would undinarily preve fatal. Much the same process of mitranslatation is constantly happening to city dwellers. You get a few psienmonia gerins, any 30st. enough to stripulate the production of a few anti-hodies in your body. A few weeks later, your get a slight v increased dose and build up at it more ant bodies. Eventually to this way you may build up complete annamas. tion to the discuss.

"NOT being constantly exposed to infection in trowded streets and places, the troutes of country people do not have to build up the numberly protection.

"Similarly, the children of certain private schools in New Jersey showed a far greater susceptibility to diphtherm than public school children."

As we grow older, of course, no matter where we live, we are; for

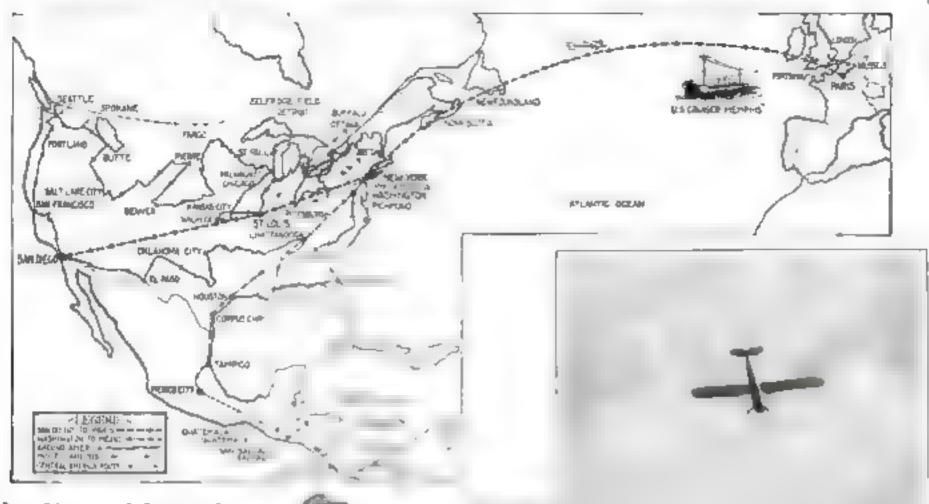
a certain degree of meaning to infectious diseases by the same process—constant exposure and the gradual creation of anti-hodies. But this does not apply to presimona and the common cold.

Most of us make the mistake of thinking that good health alone confers a certain immonisty to infection. "Investigation the worst epidemic," you hear. Let the percentage of basefull players who fall victims to typhoid is above the average. Their top-notch physical condition provides no immunity against the polluted water many of them carelessly drink while traveling around the country.

Interesting experiments were made by the late Dr. Reynold A. Spacth, of the Johns Hopkins School of Hygiene and Public Health.

Of forty white rats, twenty were regularly exercised by forced running in motor-driven drums. The other twenty were left to their own devices. After twenty-one weeks all forty were inoculated with pocumonia germs. Next day the unexercised rats were alert, bright-eyed and normal. But the (Continued on page 161)

"We" Smash More Records



Lindbergh's Plane Good as New After Flying 35,580 Miles

By ELLSWORTH BENNETT

IJEN Col. Charles A. Landbergh touched the soil of Central America on his latest "good will" hop, his famous mechanical partner, the Spirit of St. Louis, had carned him, altogether, \$5,580 miles—nearly equal to one and one-half times around the globel And this without sign of faltering, and with only a few minor repairs

While the world renewed its tribute to Landbergh as a gruess of light engineers were acclaiming the triamph of his alver monoplane as one of the amazing mechanical performances of all time. Roseing at a specifier faster than an ex-

press trains the machine had within seven months borne its pilot across the American continent, over the Atlantic Ocean, through every state in the Union, and then to Mexico City and Guatemain. And here it was, safe and abund, apparently as fit as ever'

Its air-cooled Whirlwind motor had run for more than 370 hours without a failure, surviving well beyond the average life span of modern power plants of its type, reckoned at mile trap from Washington to Mexico City, the master preclume at Boling Field, Washington, had gone over the plane and had pronounced it in as perfect condition as the day it left the factory!

The Sport of St. Louis Lindbergh at the controls map of their 15 550 mile training and seem to even with

glasses and President Colley wat hing them in Mexico.

The accompanying map shows the long trail of Lindbergh's remarkable flights since the day, last May, when he hopped off from San Diego on his great adventure. It constitutes a picture-record of unequaled mechanical and human endurance.

Lindbergh S return from France Le was quickly followed by a \$2,350-mile tour of the country. This was completed without a single overhauling, and with no mechanical difficulties or forced landings. Only one failure of schedule occurred, when Lindbergh decided not to risk a landing in the fog at Portland, Me. When, at the end of the tour, the motor was taken down, mechanics found it necessary to replace only histings, a rocker arm and two valves—after more than \$2,000 miles.

Today the Spirit of St. Louis is still good for many more mouths of service.

Colonel Lindbergh and the Special of St. Louis landing at the Velbuena Airport, Mexico City on "good will" flight to Central America.





Romance Jams the Log Jams

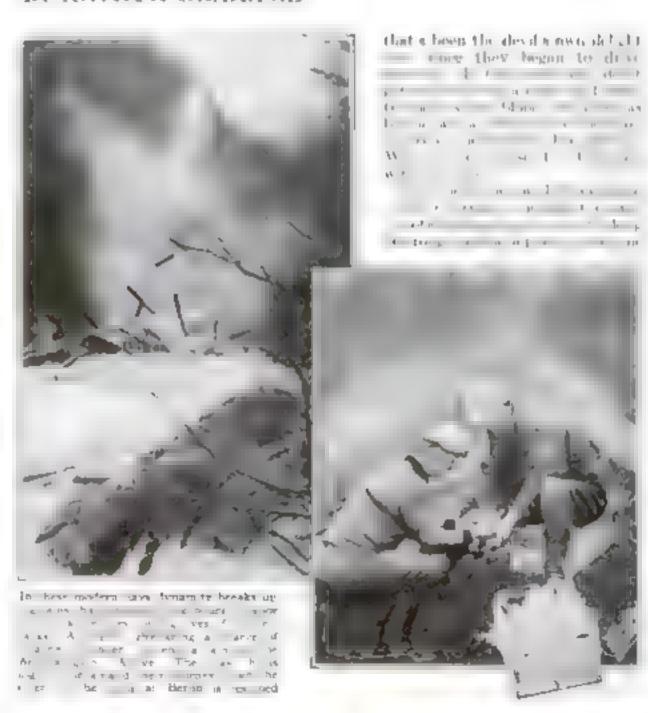
Lumberjacks Risk Lives Playing with Twenty-foot Jackstraws And Dynamite to Keep Timber Moving in Lakes, Rivers and Rapids

By ARTHUR GRAHAME

HE drive! Pulp logit—forafaot lengths of sprice desthed for the pulp creshers of the voracious paper milk-down river haw logs Iwents foot lengths of pine for the band nava of ever-hungry nucls. Thousands and thousands of feet of rushing timber, wet and slock, sometimes tossed half hin jen by abects of whate spray into the there age ingrammationer acmetimes tumbled end over-end down breath taking rapida by the fierce swriting waters of wellnamed Rapid River. Above all, approprace in use. The sullen roar of the river and the harsh crashing and splintering of timber harled victously against bool sers and rock ledges.

Uld Joe Mc Broy, veteran of forty-odd years of river driving, my guide when I west into the logging country to report a drive for the reagers of Post (Ag Sch Nex. MONTHLY, gripped my arm with a weath er-darkened hand and pointed two housdred yards upstream to a long saw log. its butt jammed hard into some crevice in the river's rock bottom. It had swong across the current and lodged its other end beland a boulder. Held in place by the terrific rush of water, it had become a rallying point for other logs, which, burked against it and up-ended were transformed swiftly into a confused spray-drenelsed pile of gigantic jackstraws.

"YOU'VE been wantin' to see a log jam," old Jue shouted in thy car. "Well, there's the beginnin of a dandy That there ledge is the worst spot in this whole aix-anic stretch of white water



to follow. The trail awang away from the river—but not out of earshot of its roar—atto the warm stillness of the woods, then, after a hundred yards, back to the river. In the few minutes that we had lost eight of it, the jam had normaned tenfold. It was an uneven, bulging wall of granding, groaning logs extending across the narrow river. Water shot its way through the many crevices in this wall, but behind it more water, and thousands of logs, were

High on the bank above the jam, we broke into a small clearing in which stood a rough shack; a man emerged from the brush access the open space from us. He was a lean, slabuided man, whose long, solemn face the winds and sums of many seasons had tunned to the rich, even brown of a long-used saddle. He gave us a beref glance, then turned his clear gray eyes to the jam. After a moment he spoke, with a Yankee drawl and in the

"YOU can't trust this old devil of a river a minute." he observed without makes. "I just went upstream a piece to help the boys out with a little harg-up -and now look at this." He strade to a telephone on the suit of the shack and apoke calmly into the transmitter.

gentle voice of the Maine woodsman.

'He's the tender-out," old Joe in formed me. "It's har job to watch the river here and see that the logs are running free. Old timer on the river all the tenders out are. It's a

right important job

The tender-out took opna prekpale a twelve foot ash shalt with a steel tip fushioned anger wise to a man could thrust it into a log, give it a twist, and then pull the timber as he seram ded down the astik. Now the walt of logs was demonstrat back most of the river's flow. and the water's roar was clunged to a sullen murmur that mugded with the emoking and group. mg of the logs beneath Lie terrific pressure. No little water flowed bekow the jam that the tender-out was able to kap from boulder to bounder into mulstream. Then, facing the treachecous. Treathar ist timber rising far

above his head, soaked by the ley water that spurted

apstefully from between the logs, he began to prod and pull with his pickpole at the tangled mass, searching for the jam's key log.

"I saw my brother killed that way," and old Joe. "That was twenty years ago, up borth of here on the Swift Diamond. He found the key log all right, and

loosened it but he couldn't get clear in time. Little the lugs and the rocks left of him. We picked his budy out of a shallow ten miles down. . . Mighty close that I came to going the same way down there on the Androscoggiu, right below Errol Dam. I was on top of a jam, alcover logs over, when out she went with me. All helt broke loose. I saw notion' but white water and grandin' logs-and then there I was standin' on a lag saw log with my peavy in my hauds and riden' pretty in a quiet

BACK in those days there was none better than me at ridn' the logs. Why. I mind once I rude one through an open alove gate, just to show off to my best girl. There a few that knows the track now. Drives un't what they used to be, and tumber-jacks am't either. There's not many left in these here wouds that can use an ax even. A feller with a cross-cut saw can fell there trees to a good.



A flume built where natural waterways do not serve in carry lugs to the nearest river or lake that will carry them on their way to the mil-

lave to blow her." From a box standing opened and handy at the door of his shack he took three yeslow sticks of dynamite and a length of fuse, then went calmly back to the jam. Working unharriedly and with method, ho

placed the "canned thunder" where it would do the most good, bent over the fuse a moment, and came unexcitedly back to shore

We took to shelter. It seemed a long time before saything happened. Then doll thunder shook the earth, and gunt logs, cent and splintered, were horiest high into the air. Before they could splash down again the eager current had sensed on the logs beaned them and hueried them on downstream. In a few minutes, old Joe admitted unwillingly, the tender-out, with a few sticks of nyr amite, had broken a jam that in 'the good old days' would have resisted an entire driving erew for hours, and perhaps hing up the drive for days.

"THEYRE using dynamite more every year" he gramuled. "It busts up a few logs, but it saves time, and time is worth more than logs these days, with lumberjacks paid higher than they used to."

Many times on the drives I listened to that plaint of the old-timers, "Lumber-jacks am't what they used to be." Perhaps they aren t, but they still do a man's job in driving the logs down white water from where they are cut in the woods to the mills. Those that I watched at work and talked with in their wangans "wangan is "costoned on jong 123)



axman's one. I mind when-"

I had been listening to old Joe with my eyes on the tender-out, playing his desperate pame of pickstraws down there below the face of the jam, pushing and pulling until the sweat ran down his brown checks and the pickpole bent in his hands. Now, as he came leaping toward shore, there was a great to-do of

shouting and singing in the brush, and a dozen lumberpacks attode into the clearing. Most of them were French-Cana-

dians—husky young fellows, with dark faces and straight black hair and bigchested bodies—who wore gausty mackmay shirts, and carried pickpoles or peavies.

The tender-out came up the bank as they prepared to descend. "It's no good," he said to their foreman. "I'll



Sperry—Competitor of

Dramatic Story of Modern Worker of Miracles Which Vastly Increase Safety of Land, Sea and Air Travel

the Sun

SPARIs, blue exad mion with a cross empired, waite misstache stood on the roof of a talk budding on the Benoklyn side of the East River and looked across a rule and a and of space at the skyline of Man-Except for a few dlummated we lows here and there, beland which corkers begreed at their tasks the butdenients of downtown New York were dack against the midnight blue beyond for Jersey holy.

I wo men wherled a stribby cylinder ion bled on a risper tired truck across

Ad set. Mr. Sperry "radled one The whole in istaclard man pulled a switch lever and across to the owers of Manhattan shot a

THE Spercy seareldight. Learn all on of forty years and more of one man a life work given a light that is ctually brighter mut for unit . I midnet up sortace, than the end got which renches the earth would be enough in it- B to stamp Ebor Ambrose Sperry as one of the world a great inventors.

Arading beam.

On August 30, 1927 the Clean, tanker Pulpit Point cleared from ban Francisco for Anckland, New Zealand, Captain Owens set his great circle.

course true South 38 degrees West by his gyroscopic compass and turned the wheel

over to Metal Mike For twenty-one days, except for an loor in detouring the Savage Islands, no honorichand totalied the helip. There were colorels on her steering wheel when the Auckland post clambered aboard.

The Sperry gyrocompann and gyrosteering device, appointions to methwork of what was merely a physicist's toy. would alone mark their inventor as one of the world's most original thinkers.

BUT the accision of the scientific world for Phiner Ambrose Sperry is not based upon those achievements alone Some calcion the greatest hying inventor. others, second only to Educon. There are men with more patents to their credit. -

he lus only four hundred or a few more but no other man host covered such a varicty of fields, and certainly not more than one or two others asve made myentions so fundamental and revolutionary Most precition are adaptations or inproverzients. Sperty a are basic

NCE in a while the public hears of Finer Sperry, as a vague figure befund some demonstration of a new light of a new application of the gyroscope soft 'g, ' please or when his professional associates honor lum with the Coller medal for aviation, or the John Frata Medal, the highest honor that can be past an American engineer by his fe lows, which was awarded to lam for

1927. But the public never sees lum. It is not of record that he ever presided at a public dioner or made a public apeceli

But he will head the commission of neventy engineers representing the United States at the International World Congress of Engineers at Tokio

In Chicago there is a fourteen were plant devoted to the manufacture of electric coalmining machinery invented by Sperry

In Niagara Falls are two great electrochemical indus-

tries making caustic soda and cidorate salt, based upon

In Baltimore a factory utilizes the

One of the early Sperry street care, first that could climb steep grades, built about 1894 Specry, in durby but, holds lever no track behind the our

serap from all of the tin can factories of America, recovering the tin and selling it to the sijk weavers and melting down the remaining iron scrap into such things as sash weights—entirely based on Sperry patents.

The General Electric Company bought the Spercy patents on electric street cars capable of climbing steep

grpules.

In Brooklyn the Sperry Gyroscope Company, which makes the gyrocompass, the gyrosteerer and the gyrostabilizer for ships, and builds the Specry searchlights, occupies a twelvestory building at the end of the Man-

hotton Bridge

heere pavy and great merchant fleet in the world uses these Sperry inventions for mavigation. Every navy and most of the armies use Sperry searchlights. The Sperry perial forpedo and a dozen other war mac ones. some of theat among our Covernring the most excel by granded secrets, stand to his cred to

WHEN Prof. V.A. Machelson, the great physicist whose investigations of hight are of extreme importance in secondific research, needed a light canal to sambght for his experimenta, Isaner Sperry alone could farrish th. And when Professor Mehebon's work called for flywheels with the incremble speed of 40,000 revolutions a nounte, Sperry glose could design and build them.

The might flyers of the are mad fand their airports by the aid of Sperry search lights. their beams visible at far as 140 mil-s. from their source, a motor g a believe guai a quarter candlepower into the sky.

Practically all motion pict one today are made in windowness attached, for the perry cartude are light makes possible better lighting effects, even for supposedly out toor scenes, than the nun-itself

Why, I wondered with such achieve ments to his credit doesn't the public know more about Elmer Sperry the man?

I went to see

I found him at his desk in Brooklyn His tanned face and springy step belied his sixtyцемен уевтв

OH by the said, as we spoke G of a monthal friend, now long passed into the beyond. "golf woman have kept him save

He didn't know how to play He spent all of his time working the worst thing

any man can do."

sperry is a member of three country. clubs on Long Island, where his own magnificent sommer home is also ait inted. at Bellport. And he plays better golf

than many men of his years. Let than same man works longer hours than any other man but Edison

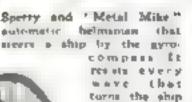
The thing on which the great inventor is working now in all electric fissure detector, to discover and mark faults in ruleood rails by electrical measurements made while a car containing the matrument passes over the line On a length of railroad track set

up in his factory tests are being made What may prove his greatest invention is a radically new type of avustion engine. which weight no more per horsepower



Elmer Ambeuse Sperry, one of the greatest wing invention and one of the least known to the pult- he gong his engineering pressus and creative power are equaled by his modesty

An efective eutomobile built by Sperry before gooding became the standard for horseless carriage peopulation. For this he deviced a repairment forage bettery exill present timber for other purposes



from its course.

than the best now in use which requires a third less furl to produce the same power and that fuel costing only a tenth as much as gasorie and noninflammable. It doesn't take much imagination to appreciate what such an engine will do for aviation, espeenally as it has no complex electrical equipment to get out of order.

THAT is the supercharged Diesel. I type amplane engine which Sperry has developed after nearly thirty years of experiment. He has built a number of supercharged engines of other types many of them being successfully used in racing cars and airphoes, but be never was astisfied with the form-cycle gasomic engage it assured too complicated. The Dresslengue is anaparenty itself once the weight factur run be cut flows. ' he test me

Everybody realizes now that the failure of an many long distance flights was due to the weight of the gasober which had to be carried Crode oil or distillate, which is the

> Diesel engines fuel. weight a theo essent my problem has been to find a way to make it give more power per gallon with no mercase in the weight of the er gime over the best of the gazoline type

There were landy romplications in the pronlens, but the present copine, the eighth in the experienced series, is 8 I to lucve solved them.

WHAT is your letthe gyro? I asked.

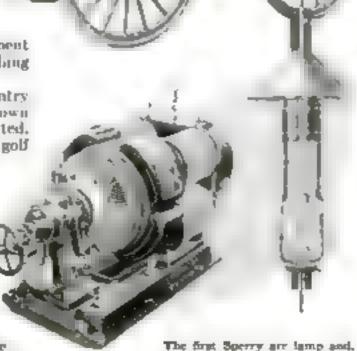
The automatic track recorder be repose "That was for shed about a year ago. It is used by milroads to determine the condition of the roadbed. The gyroscope, as you know,

can tell if the object with which it is a contact is moving, and in what direction. and if tilted, just how many degrees This track recorder mechanism is the pited on a railroad car and tun at any speed. It makes a record on paper felling not the degree of banking or every curve, chether the rads have spread at any point, whether the ties are firmly bedded or are center-bound, so that one end saks under the weight of the train. The engineers can take the picture the gyroscope draws and send their repair gangs to the precise points where tangs are

The recorder has been in use on the Santa Fe tailroad for about a year, and is now being adopted by other made.

"I wish you'd explain the working of the gyroscope to me." I persisted "What can it do" And how did you come to think of putting it to work."

He picked up a brass model from his desa. Just a little flywheel, heavy at the rim, light at the hub. Each end of the long axie was held in a bearing in a ring of brass, just big (Continued on page 102)



at the left, the first Sperry electric dynamo which provided the nurrest. From a tower in Chicago a battery of these are samps cast 48,000 candlepower, a marvel of the america

Where Did You Catch Cold?

Maybe from Heavy Meals, Smoking, Kissing, or

From Your Neighbor-Some

New Discoveries about

Our National Malady

By P. A. CARMICHAEL

HOMAS A. EDISON has said that the American people cat too much. The great inventor speaks with authority; he knows the importance of right eating. To the fact that he has long kept to a light diet he attributes much of his ability to work more hours a day than most men.

If it is true, as many doctors maintain, that we have be supprising that we sometimes eat ourselves sick. But how often does it occur to the man, woman, or child suffering with a cold that he or she has caught

it from eating?

Yet what we eat has been found to be the primary cause of many of the colds with which we as a nation infer. Take, for example, the banquets, parties, and Sinday dinners when we are tempted to overindulge our appetites for neh food We may soon suffer from singuishness or indigestion, but we also are inviting that insidious adment for which we usually blame the weather or somebody's sneesing—the common cold.

Dr. Volney S. Cheney, medical director of a Chicago packing plant, susperting that colds among the employees were due largely to overcating, kept a record of them and found strong evidence that his suspecions were correct. On days after banqueta and on Mondays and days following holidays, the prevalence of colds

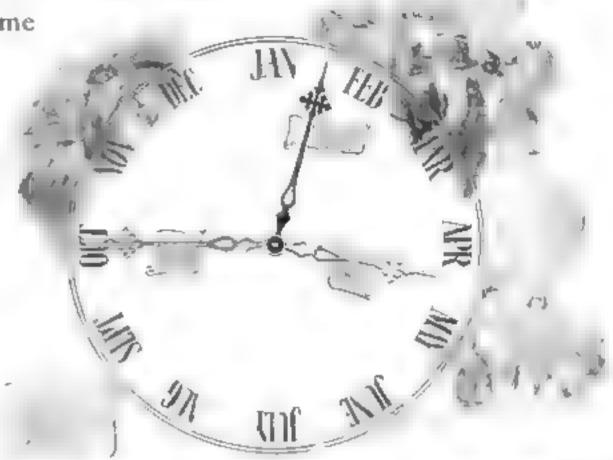
was greatest.

The explanation, Dr Cheney said, was fundamentally the enting of too much meat and other protein-containing food. This unboatized the system, generated and poisoning and combined with lack of exercise and perhaps with other ail meats already present in the body, paved the way for colds. The remedy, he said, is a diet containing plenty of vegetables.

We not only ent ourselves into colds, but some of as smoke ourselves into them. Many a man, intent on some task, excitedly lights one rigarette after another and presently finds himself hourse.

"WHAT have I done to catch this infernal cold?" he asks. He runs over the events of yesterday and the day before, but can think of nothing he did then to induce a cold. The consequence is, he ascribes it to some mystery in Nature.

Let us suppose he had gone to a doctor. The latter would have examined his throat and, finding it inflamed, probably asked whether he smoked. When the patient had recalled his excessive smoking of the day before, the explanation would



have been clear. It would have been then The smoke irritated the delicate mucous membrane of his throat allowing the germs constantly inhabiting the mouth and throat to penetrate the fiesh and set up the inflammation.

bometimes a surprisingly small amount of precaution will prevent such a cold For putance, Dr. Russell L. Cecil. professor of clinical medicine at the Cornell University Medical College, reports cases in which even a change in the brand of eigstettes has been effective.

Col DS of this kind show how it is posmble to contract the niment without exposure to other sufferers or to had weather. The reason is that we are constantly beset by an army of microbes camped in our mouths and throats. These invisible invaders are always ready to attack. Of course, they do not succeed at every opportunity, for there is an opposing army of corpuscular defenders in the blood which, when the system is in good order, usually repulses them.

Not only excessive amoking, but such things as dust and gases, extremely cold, dry air, over-use of the voice by speakers and ungest, and digestive disorders, which send up substances that roughen the membrane, may cause colds.

This is one kind of culd. There is another

When you kas your maiden aunt—or, for that matter, your best girl—when you shake hands with a friend you haven't seen for six months; and, of course, when you fall within range of the feilow who charges the atmosphere with germs by coughing and soccang when, in other words, you come in contact with carriers of the germ, you are in danger of catching this second variety of the disease. Strange to say, this kind in contagous;

whereas the other kind, which we catch without contact and without exposure, is not.

To demonstrate the contagiousness of the accord variety, Dr. Peter K. Ohtaky, of the Rockefeller Institute for Medical Research, conducted a series of interesting experiments. He took washings, or cultures, from the throats of cold sufferers and with these swabbed the threats of several well persons. The result was, with few exceptions, that he produced typical colds. In the cases where the colds fuiled to "take," the persons from whom the reftures were obtained had been infected eigliteen to twesty hours, whereas, in the other cases, the infections were only a few bours old. All of which indicated that robis are communicable in the early stages but not in the later

So far as medical science knows, the agent which causes colds may be so number as to be invisible under the most powerful increacepe. Dr. Olitaky put all the washings he used through the finest filter, thus straining out all the known hacteria, and yet transmitted the disease. He concluded, therefore, that the cause is

apparently a fifterable virus.

GFNERATIONS of warrings against Carposure have left in most of us an almost instructive dread of cold or damp weather, in which, we think, there turks our death of cold. Lately this idea has been widely challenged. Colds, we have been told, are not caused by exposure, but by germs. The question has been investigated experimentally, just as was that of the transmission of colds, with the result that we now have the findings of science for a ginde.

In St. Louis, at the Washington University Medical School, a group of volunteers submitted (Continued on page 130)

A New Brood of Lindberghs

How Uncle Sam's Sky Classrooms Are Teaching Awkward Fledglings to Become Great Flyers

By MAJ, GEN, JAMES E. LECHET

third at der Corps, U.S. Army

Brooks Field, San Antonio, Texas, a hiplane skiddled uncertainly in watersweeping circles. In the cockpit a goggled young flying cadet.

right hand clutching the "stick" feet moving gargerly on the rudder controls, struggled in the gap of a strange predicament

Here he was, up on his first solo flight and for the life of him he could not get down to carth again." Worse stall, the fuel tank was run-

ring dangerously low!

For fully half an hour be had been channg round and round that endless circle, hawklike. Directly below he could are a curving row of little hard houses—the hangars and harracks of the flying school. Beyond, to the southwest, miles of farm land stretched away toward.

the Gulf of Mexico.

HOW to get down? He tried to repeat to howelf the directions often given by his instructor. He tried to bring back the "feel" of the ship on previous occasions when with dual contropy the veteral protection of the world demonstrated to him how minple it was to land. But try as he would now, he could not bring hosself to make the dive to each.

On the groups a group of officers

ingualed fronticul v

If that boy is sitting around up there wanting to fall down," groundled one, "be won't have to wait long

Amost as he spoke, the engine of the plane mused, sputtered and ched. The officers watched authors v. A stall 4 sickening tail spin—anything might hap-

pen now. Instead, to their surprise. they naw the nose of the machine sink slowly and deliberately. With a graceful glide, the powerless plane winged downward until it swept to

a perfect landing

The cadet stepped from his ship, granning sheepishly. The officers, vestly relieved, could only shake there bears and lough at this "ground shy" ftedgling who could use to the do-or-de emergency with instructive resourcefulness and find his wings. True, he had brought the emergency upon himself, but in meeting it he had laid claim to that covered possession of every great pilot, the flying instinct

With a fresh supply of fuel the cadet took off again, and again landed, thus time under power.



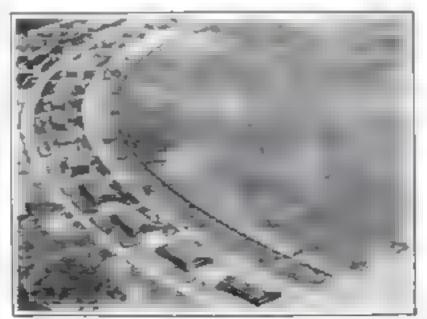


One of the many thrifting experiences of the advanced air students, moneticum for practice and nometimes to ease their lives when they get lose difficulties — a parachate jump. The fiyer is seen tolow the nirplane which specie on the perachate is just beginning to unfold

Major General James E. Fector, Chief of the Alt Corps of the U. S. Army

Tune and again be repeated the performance until his original shyness of the earth had been conquered. Today, having completest his schooling, he is a cruck pilot of a large custern air line.

ON the first of this blarch more than two hundred ambitious young men, like this cadet, set out to try their wangs



Training planes lined up at Brooks Field, Tex., Primary Plying School, ready to start the day's fights shortly after 6 o clock A.M.

at the two Primary Flying Schools of the Army Air Servne—at Brooks Field and at March Field, Hiverside, Colforms. They are from virtually every state in the Union, Most of them never

bave ridden an airplane, por have they a clear idea of how it in built or how it works. But all are fired by the desice to fly and by the ambition to find a successful career in the air

SOME are destated to intered apectocularly; some wall prove to be naturally tarfit and will turn to other pursuits for which they are better adapted. From this raw launch of groundslings, kowever, wik emenge men who wil. be among the great pikets of tomorrow men trained in the same thrilling school of experience that helped to produce a Landbergh, a Chamberlin, and many another ancessful fiver of today

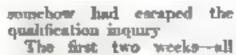
They will find many opportunities as officers in Army flying units, in mail or the varied commercial air lines, in designing and building airplanes. The whole fuscinating realm of aviation, you are, opens before these prospective pilots.

Under the Government a five year program of expansion in aviation, the Air Service stands in need of skilled officers.

That is a cluef reason these youths are being given the great chance. At present our air forces are undermained. We have less than a thou sand pilots, less than 9000 enlisted men, and 205 flying cadets. I nder the new program we shall require at least 1050 commissioned officers, 1600 nerviceable airplanes, and 15,000 enlisted men, including 500 flying cadets.

BUT to enter a Primary Flying School one must measure up to definite qualifications. He must be between twenty and twenty-seven years old with two years' college training or its equivalent sound as a dollar physically, with perfect bearing and right, and well recommended as to character.

Arrived at the flying field the



"ground work" pass some what tediously for the boy who as impatient for the air. In the first week he must learn military fundamentals; during the accord he gains his first knowledge of the theory and mechance of flight

THEY the third week hrings the great day when he goes up for lus first actual flying distruction.

Proudly be appraises the machine he is to ride. It in a PT-1 special training biplane. deagned for stability and low

landing speed, and driven by a 150-horsepower motor. Its fusciage is all metal, with strength to withstand a severe crash. The instructor clumbs into the front seat, and the student takes his place in the rear. That first flight is little more than a might-seeing tour, with the instructor presiding, but the pupil acquires something of the feel of the ship. Next morning the cadet has his first lesson in handling the controls. These are in doplicate, one set for the matractor, the other for the pupil. On the edge of the upper wing are mounted the instruments in view of both men-air speed indicator, altimeter, tachometer and oil gage. As they fly the men converse through speaking tober connected with the earmores of their belmets.

The future pilot obeys the commands, studying the movements of the mechatmen and the response of the ship.

FOR days this sort of training contumes. Then at last, at a height of about two thousand feet, the instructor holds up his hands to show that he has relinguished control, and the youngster has his langed for opportunity. Nine times out of tenthe plane begins to skid and alide crazily about the sky and the mstructor comes to the resenc. But soon the putal finds the more balance between rudder and microns that keep the machine straight and level. Every day brings some new achievement-first gentle turns, then steep turns, spirals, and landings, then aerial acrobation, especially the tail ages. Almost invariably, when a pilot stalls has plane, it goes into one of these vertical spans. The controls go limp, and have no effect. Eventually

out of a tail spin by kicking over the rudder to form a pocket which estebes the air, lifts the tail of the ship and brings the

liter about twenty half-hour flights with his instructor the popul, if he has shown steady progress, as ready for "somwork." If he has failed to progress, he faces the "benzine board." Other instructors go up {Continued on page 15t)



such so he will have in breathe in high Bight

beginners are brimful of enthusiasm and confidence, but before many days they tegar to wonder if thus flying thing is as simple as it looked.

To be aure, almost anyone can learn to dy an arplane, but to be a successful a divery priot a man must fly instructively. as if his slop were a very part of homself. ruch a pilot is Landbergh. It is this socalled "inherent flying ability" that enables a military pilot to make half a dozen over decisions in an emergency, or to perform such tasks as map making and photography with hardly a thought of the mechanical operations of flight Street!

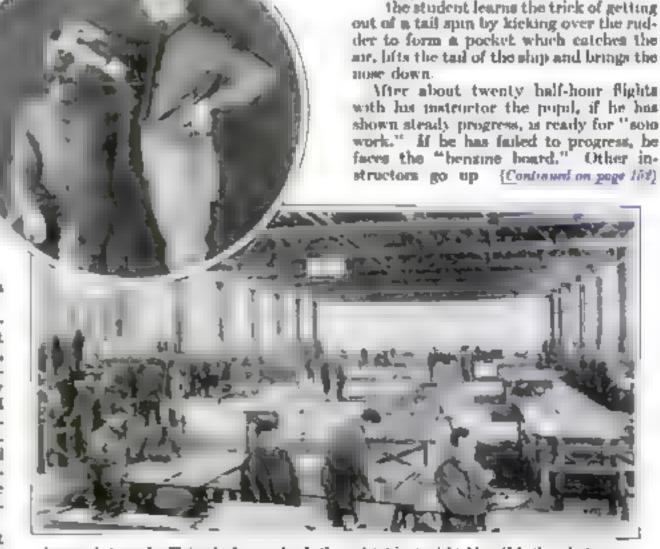
Consermently, the carliest expensives of the flying cadet are those for determining whether he possesses that chisist quality whether he is a born flyer.

#OST surprising is a ma-M chone known as an orienfator, which reveals the man's ability to "find hunself" when whirled and tumbled about by the evolutions of a plane. In a cockpit suspended within

three concentre rings, the "polot" is looped, rolled and spun il rough every conceivable experience and joist bring himself back to an even keel after each upset.

There are other ingenious testing devices-for example, a whirling chair that determines a man's sense of equilibrium, matruments that test his judgment of distance, machines that measure how readily his muscles respond to a sharp command or a finshing signal. In addition, searching questions disclose his family and personal history, his babits, peculiarities and temperament—all this to reveal any nervour weaknesses which later might cause lim to break under trying circum-

Some time ago one of the most brilliant. cadets crashed two days after he gradustion. Later it was discovered he had been subject to occasional fainting spells which

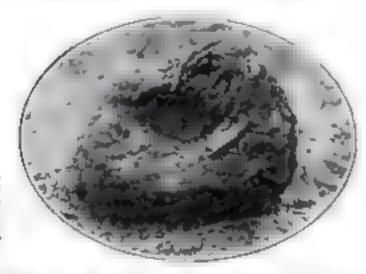


Upper photograph. Flying back over head, the endet tries to right himself in the priestator, a corkput operated to deplicate the evolutions of a phase by the untructor seated user by. Middle: Testing vision. A cadet at either flying school must see perfectly without glamen. Lower Flying cadets learning how to repair wings, histings and propellers in the woodworking shop of the school

Bits of Old Clay Kick up a Big Row

Bitter Dispute Divides French Archeologists—Are Carvings Dug Up 10,000 or Only 10 Years Old?

By GEORGE LEE DOWD, JR.



A Glosel fied. A glay block that may have held a fitone Age idol. Did cavemen or a joker make it?

HREE thousand so-called prelistone reses, dag from clay two feet under the soil of a peasant a farm in the hamlet of Glorel, France, to-day have divided French archeologists into two bitterly hostile camps in a controversy to determine whether a fascinating new chapter shall be added to the early history of mankind.

One group of experts pronounces the relica the most important of European archeological discoveres. In seemingly ameient stone implements weapons, vessels, carved bones and inscrined tablets they find evidence of a remarkable Stone Age civilization which they believe existed in Western Europe perhaps as long ago as 10,000 years—more remote than ancient Egypt.

Opposing these Glosel believers are

equally respected experts who contend that the entire "find" is a gigantic hoax perpetrated by some industrious jokesmith.

THE conflict came to a head a few weeks ago in the report of a special for ternational Commission of Anthropologists, eight in number, appointed to decide if the relics were genuine. The report called the "discovery" little more than a daring and ingenious fake.

But this funding only fanned the conflict to greater heat. Immediately the Glosel believers charged the commission with hiss and fraud and, led by Saloman Remach, Director of the Museum of Saint Germain-en-Laye, took

their grievances to the French courts. There the matter bods at the present writing

It all began in 19th when the plot of a French peasant bride brades, turned up a number of extraors and apparently annest implements and assembled clay tablets. Dr. Morlet a physician and autiquarian living near by in Viets because interested. Searching farther he and others unearthest thousands of visces, area, that arrowhends, bone harpoons atones with ground edges fragments of glass vessels, and also evidences of an ancient tomb.

tablets, seeming to indicate that perhistoric cave men used an alphabet centuries before the ancient Phoenicums, generally credited with the invention of the ABC's. The inscriptions included more than a bundest again and characters. Cursounly, half of these bore striking resemblance to Phoenician, old Greek, Etruscan, Latin, and other ancient writings. Certain ayinbola were annihir to those found in such far separated parts of the world as Peru, New Zealand, Scandings in and Mexico. Others were

entirely unrecognisable.

AMONG other surprising discoveries were more than a dozen clay figures representing the homeon face, with round even, but without trace of a month! Carvings of reindeer heads appeared on sinal stones and pieces of bone.

Hemsels attributed the relies to printtive people who probably were common to what are now France, Spain and Portugal. Later they vanished possibly augmining to the east under pressure of

> arvaders from the north Thu, he mays, might explain the similarities between the Glosel inscriptions and the writings of early Mediterrances peoples.

"The collection," says the communicate, "in samply the

invention of someone who had wit enough to place some genuinely old axeleads and other fragments with others of bone and pottery which he had carefully and patiently fashioned lumsuit."

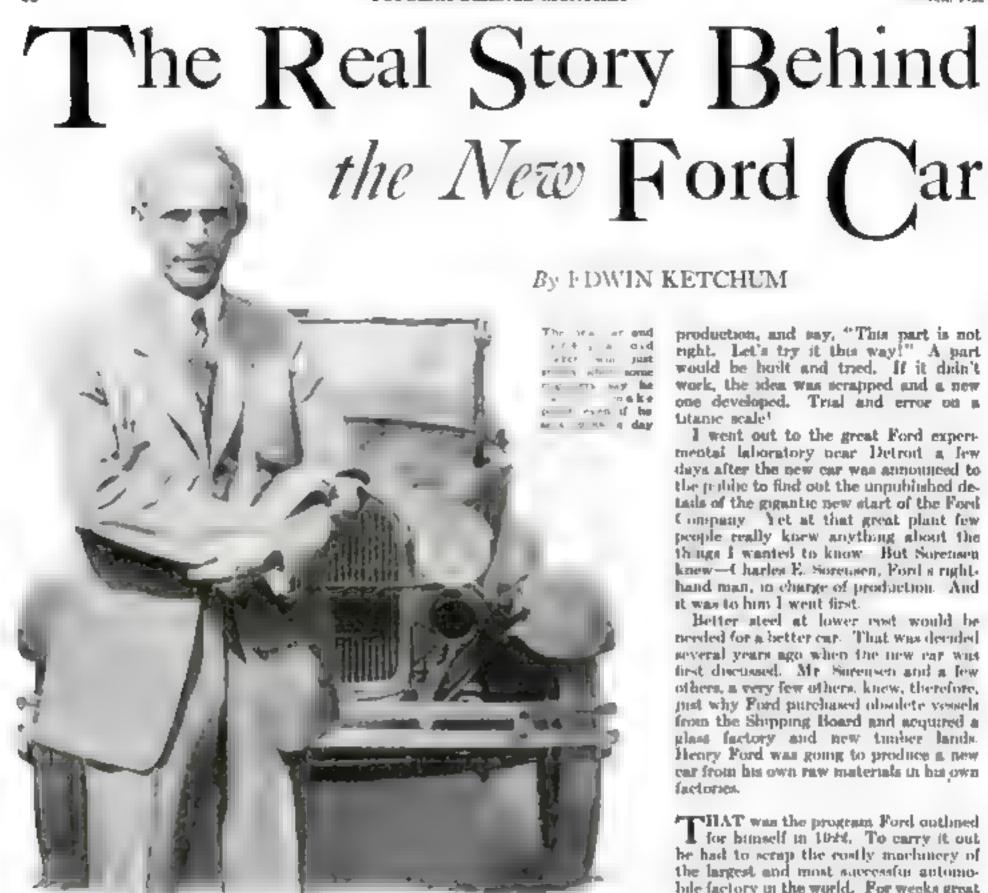
The commission contended that the curvings bore every evidence of having been cut with modern metal closels, that an "ancient" over uncerthed was not over seventy-five years old, that many of the "prehistone" bones actually were new.



Part of the "Minerum of Glossel," showing noise of the relice of which it is the crude temporary repository. The most interest ing feature of this group is constituted by the strange bowls which represent human form with eyes but without mouths



The scientific may gets first-hand information by visiting the scene of the find or the "coine" of fahery, as they adjudged at -on the farm at Glosel. France



OWN a Michigan road, not long ago, rattled a dilapidated "tinlizzie." Over the steering wheel erouched a tall, gaunt grayhaired man; a small boy at his side.

Henry Ford was the man. The car was a new Ford, secretly built and disguised. under a body of ancient vintage. The amail boy had been picked up along the road-ule because Henry Ford wanted from his lips an unbased opinion of his new car an opinion he could get in no

Ford a new cars, already dotting the highways, are the climax of the most spectacular drama in the history of the automobile. One man, by sheer driving personality, dominated it. Success, wealth, fame were his, yet he would not sit tille and let others build his new car. Ruthlessly be scrapped men and machines and started over again. At mxty-four he undertook the bardest task of his life, harder even than the production of his first car more than a quarter of a century ago. He was everywhere at once, passed on every idea, tested most of them personally. Never before has there been such a story of an emergency autocratic control of a mammoth industry—of inventive persistence, and inventions made

to order on a huge stale.

Ford sessed the first new model as it came from the assembly line at the great Fordson, Illinois factory. "Is this the best you can do?" be asked his engineers. ") es. they told him. "I'll represent the public, then." he said, and a second later the car with Ford at the wheel, leaped out upon a near-by field. When he returned, after humping over stones and logs, he declared, "Pretty good, but it bounces. Put on hydraulic shock abnochers."

AND so, day after day, the new Ford was changed and modified and improved. Ideas for integral parts came from chance remarks of his aides, sometimes on country drives for from the designer's room. Frequently Ford would enter has factory, already engaged on

production, and say, "This part is not right. Let's try it this way!" A part would be built and tried. If it dain't work, the idea was scrapped and a new one developed. Trial and error on a fitanie scale!

I went out to the great Ford experimental laboratory near Detroit a Jew they after the new car was announced to the public to find out the unpublished details of the giguntic new start of the Ford Company Yet at that great plant few people really knew anything about the things I wanted to know. But Sorensen knew—Charles E. Soreusen, Ford a righthand man, in charge of production. And it was to him I went first.

Better steel at lower cost would be needed for a better car. That was decided several years ago when the new car was first discussed. Mr. Surensen and a few others, a very few others, knew, therefore, not why Ford purchased obsolete vessels from the Shipping Board and acquired a glass factory and new tumber lands. Henry Ford was going to produce a new car from his own raw materials in his own

THAT was the program Ford outlined for himself in 1926. To carry it out he had to scrap the costly machinery of the largest and most successfur automobile factory in the world. For weeks great machines had to stand alle. Thousands of men had to be thrown out of work temporardy. Ask any biastiess man what it means ai dollars und ceuts to stop such a plant for even a day, and you will have some idea of the courage it took Ford to determine to biild a new car whose success no one could foretell.

First there was talk of making the momentous shift after the ten milhouth lizzie had been made; but "There never seemed to be an opportunity to get the new car started. Ford said, so the lifteen nullionth Ford was set as a tentative turning point.

Meanwhile Ford laid down his fundamental orders. "Build a car designed for a need, not any definite price," he told his engineers. Specifically, he demanded a machine that could go sixty miles an

k male a manute! That called for a fortyhorsepower motor. Shall it be a fourevlinder car or a six? Ford demanded a low speed motor. Such an engine, spinrong its crankshaft 2600 times a minute, can develop forty horsepower with four evhoders. A four it was to be, then, Better make the cylinder chambers about as wide as the distance the pistons



Henry Ford's R yer Rouge plant, which in \$946 courses 65 a not not how an one of the lattle planes in on new Ford u.s. or ques more from \$15 a fee. This does not a late stee attraction devoted to breaking up 199 old ship to options he a material up maying the new Fords

travel up and down," Ford directed explaining that he favored the "square curie with hore and stroke he make all.

So bord, master engineer had his took healt into the motor that was to rive hes created an entry view motor from the ground up. Strength Plant must be the kernote of the crankshuft—the sturdy looped whiches shaft through which power from the alamonum potent flows to spin the early wheels.

Was it balanced? In action as well as at rest? Ford wanted to know, for if it was even a tribe unevenly weighted, it would vibrate and shake the whole car. A precision testing machine proved its balance.

Till? engine was satisfactory. "All right," Ford and, "Bodd a compact car around it. A light car, but one that will hold the road." Some of those engineers may have told their wives that the task was impossible, but they didn't tell Henry Ford.

It is the "unsprung weight" of a carthe weight of the wheels, axies and everything not hung on springs, that jults and bounces when it strikes holes in the road. Ford found unsuspected ways to eliminate unsprung weight—a rear axie housing of spun steel, steel-spoke wheels, changes in the front axie and the new four-wheel mechanical brake system, all lighter without loss of strength. Even the springs themselves, usually attached to the axie by their heavy end, were reversed so that their own weight would be "spring"!

Now an up-to-date gear shift was required—a break with years of Ford precedent. The frame itself, forged throughout, for strength. Colors, too, for the body—Edsel Ford chose for his father the two shades of blue, the gray, and the sand-color that became the new finishes. Accessories? 'The best,' Ford said. Even the old familiar "squawker" born was scrapped.

THERE was the car—on paper, but there were no machines in existence that could make, in quantity, some of the things that Ford had put in it—a gasol ac tack electrically welded of stell covered with 111 s. rest each also for every tell. We have sent our two tails elected bond trailers.

Ordinar this eater hing machines couldn't make the gas objectation because the current sputtered and faded morning fardy as it flowed through the bearings to the welding disks. One of Ford's man but a on the scheme of ranging the bearings of electricity, and that problem was solved.

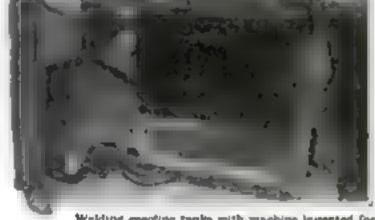
axle bousings, a device like a huge potter's wheel was in vented. Instead of clay, it which a red-hot forging; a special forming tool pressed against the metal flattens it into the desh-shaped housing. Now that machine makes three

a minute.

Thus new machines were invented. Existing ones were modified. Ford found that he must scrap and replace a quarter of all his machines, valued at forty-five indion dollars! Half could be made over the remaining quarter could be used as they stood.

The secret of the Ford success has been mass production, developed to a degree that left men of lesser imagination gasping. Now he would make them gaspagain. He would not only make the cars, but make the materials that went into them. Besides his own steel plant, he built a factory to manufacture unbreakable, three-ply glass for his windshields. Fuel for his plants came from his coal properties in Kentiicky and West Virginia. His Michigan timber lands supplied him with wood. Obsolete vessels went into his furnaces and emerged as metal for his ears.

Then Ford faced the greatest decision of his life. Should be stop the plant in the midst of production and go shead with the new model? Or play the safe course, stack to the old familiar car and the parts business? Millions were at stake.



Welding greatise tanks with machine invented for the purpose. Mercury keeps the current constant

"We'll make the new car now," he said, and one spring day of 1927 he drove the fifteen milhouth old-type car off the Highland Park assembly line. Then the plant shut down.

Out came the old machines at Highland Park and Fordson. New machines spring up—among them forging presses that shaped frames of cars at one mighty blow

Then came the Pordson plant's galaday. Down the assembly line rolled a aloning new car with Sorensen at the wheel. Behind it came a second, a third. Here was the new Ford!

And yet Henry Ford wasn't satisfied. He disguised a few of these first cars and started picking up small boys around Dearborn to get their verdict. He got it and gave the machine to the public.

How much dai it cost? No one knows. A staff of accountants could easily find out, of course. The point is that they don't. Ford apparently doesn't care how much it cost and obviously be isn't worned about those engineers who say he can't make money on the new car

"When we began work on the new model, we had \$350,000,000 in the bank. Now we have \$250,000,000," he said.

That is the story of how one man built a car that set the world talking.

What We Owe to Newton

The Story of a Farm Boy Who Built Queer Toys, Made the Universe Hang Together, and Became One of the Supreme Discoverers of All Time

By ARTHUR A. STUART

N ENGLISH farmer's son, rather dall in his early school days, who carved his name on a stone window all when he should have been country has lessons and spent but leasure at home in making doll furns-

ture for girls and queer toys for hinself, received the homage of the civilized world durmy the last year on the two lumifiedth anniversary of his depth.

He was acclaimed as one of the apprene discoverers of all time, a scientist with few equals through human hutory

If Darwin and Anstotle are excepted, who else can stand beside hun who found the laws materlying the movements of all celestral bottes and put into mathematical form the poet's music of the BD berra?

bur basse Newton made the universe hang together by the bonds of gravitation. He gunranteed the scheduled arrival and departure of every heavenly hody, whether speeding handreds or thou sands of males an hour. He proved the regn of physical law on earth and extended it to the atmost abyas of space. He reposeed chance with certainty, fear with rational assurance and superstation with knowledge. He increased the dignity and statuee of man. Someone has said that all of us today are standing on Newton a shoultheres.

WE HEAR that Em has made Newton a back number out of date and obsorde. Nevertheless the imverse still proceeds according to the dany time table devised by the English matter. matician. Eristria himself concedes that the laws of his predecessor continue to have a practical validity. Planets vet swing in their orderly paths and are spaced with relation to their fellow planets and their sums by the rules of mass. motion and gravity as laid down by New ton. Doubtless Expetern has found new truths. They do not cancel but extend the old ones.

Despite the popular idea, Newton was not the first to discover gravitation nor

to find its exact law. Why then do we honor him? The answer is given by Dr. Paul R. Heyl of the U. S. Bureau of Mandards:

"Newton stood head and shoulders above his contemporaries because he had

forth in it is part of our common berstage, station from ta

Some reader may wish me to clarify further the accuming contradiction between Newton's greatness and his stated lack of originality. Let us put it thus:

Others guessed, he proved. Others collected bits of knowledge mingled with error, he selected the elements of truth and assembled them into a

mighty edifice,

AT THE age of twelve near the bottom of his class in public school. One day another boy gave him a kick on the stormeh, which ocramoned a great deal of path." Thus was the most salutary and useful kick in lastory. It woke up Isaac completely and was the tuening point in his career. He saw more red than he ever discovered later in the apertrain, potential his assailant to a standstill and as a real been took but by the cars and runbed his form against the charely and wall. hause a chest expanded. Then he realised that the boy he had whipped stood above him in school. This would not do. He resolved to wer a mental as well as physical victory over has foe. He began to study and carned first place ua selical.

At bosse Isase had a kit of fools and amused hinself building models. One of these was a windrell like a bug one in the neighborhood. To make the windrall per-

knowledge before his day consisted chiefly ingged up a treadwheel on which he installed a mouse, which was lared to travel forward by a best of grain hung just beyond its reach. Isaac also made a water clock. This was feamed in an old bux and stood four feet high

> THE dripping of water on paddles or A the like was the motive force and caused the dial hands to regater. The boy kept the device in his bedroom and gave it a day's allowance of water every morning. It was such a peactical clock that everyone in the house kept time by it.

As an improvement on the water clock, Isaac turned to sundals. The first ones.

NEWTON'S SIX GREATEST WORKS



By discovering gravitation as a universal law, he brought order out of chaos. knowledge out of superstition.



His improved methods of calculation placed knowledge and achievement on a basis of mathematical precision.



He guaranteed the movements and positions of heavenly bothes, and so made safe, exact navigation possible.



His spectrum analysis of white light payed the way for a host of useful optical discoveries and inventions



He originated a mathematical basis for all modern physics. For isolated facts be substituted the rule of law



He invented the reflector telescope. By study of the stars he gave to the world a wider view of the universe.

vision, a broad mental grasp. Scientific form inside the house, the boy inventor of isolated facts. . . But Newton was able to visualize all the moving bodies in the universe from copets to falling apples, and to demonstrate that they all obeyed a single law universal gravitation. He brought order out of chaon, he had constructive talent, he was a builder "

No book as epoch-making as Newton a "Principia" appeared until Darwin's "Origin of Species" was published in the maddle of the last century. The first book dealt with physics, or matter, and the account with biology, or life.

Today the "Principa" is taken for granted, the picture of the universe set

were based on rough observation of where shadows fell on house walls and roof at different times of the day. Wooden pegs were placed "to mark by their shadows the hours and half hours." With increasing knowledge and skill, the youngster produced more accurate mindials. He curved two of them on the masonry walls of his home, and it was said the neighbors came around to ascertain the correct time by what was known as "Isaac's Dial."

THE reader and I may smile over this nucleat gradeness; we have clocks and watches galore and the daily check-up of radio time from Washington. Yet on second thought we get our time from Isaac Newton as did his neighbors. That radio time signal is merely the transit moment of a star whose apparent movement follows Newtonian law

Young lane made a borneless carriage which was propelled by the power of the occupant. Lacking amouth roads and hall bearings, this ancestor of modern velocles had no clunce. There was better lack with the manufacture of paper lates. Somehow the boy knew how to figure the proper shapes of lates and where best to attach the strings. By nooking a paper lantera containing a lighted candle to the tail of a late which he launched at night, Isaac scared the country people into thinking they are another comet, which was supposed to portend disaster.

There was the gentle pastene of making doll furniture, an tables and cupboards, for get friends. No doubt that furniture was done to scale. One of the giels, a Miss Storey, might have become Mrs. Newton if the young man had been financially able to marry. While in the period of entering to the dolls or girls, whichever it was, Isane wrote verses and drew diagrams and pictures which he reduced and forward to describe his morn.



The discovery of the spectrum. Newton let sunlight possibly upon through a hole to the window shutter and then through a glass prism, thus separating the white light into its color elements.



So lease Newton, from an old portion. "I seem to have been ally like a boy maxing on the scatters white the give a can of troublay all and a vertex of the me

The verses were probably a total loss. Concern poetices pornered to optical diseasers. Diagrams, were the essence of List few ark.

Isaa a father had ded before he was born files. I was thought the bear had the makings of a farmer but when he saesen but ifer st in agriculture, brightened up in school, and was found one day doing a mathematical problem under a hedge, they decided to further his education. Around nineteen he en-

tered Cambridge University. At a village fair he bought a book on astrology, and

in order to understand this dubious but popular mater of astronomy he saw that he needed more mathematics. So be invested in a copy of Euclid. And like many youngsters before and since, he felt that the father of geometry dealt in selfevident kindermrten truths and tossed Euclid away "as a trifling book." Newton then proceeded to bog himself up the advanced geometry of Descartes. At length he realised that kindergarten truths were the necessary foundations of knowledge, went back to Euclid and from that time made more orderly progress.

As with other genuses, the germs of great discovery came to Newton when he was young, a college student in the early twenties. He then invented the mathematical method of fluxions or calculus, analyzed white light into the rays of the spectrum and had his first gimpoe of the law of gravitation. It was probably in the autumn of 1665, when

Newton was twenty-three, "that the apple is said to have falled from the tree at Woolsthorpe, and auggested to Newton the idea of gravity. Voltaire had the apple story from the favorite nace of the great beginning, and we not it as well to sevent

When sitting alone in the garden and speculating on the power of gravity," writer Sir David Brewster Newton's



A letter written by Newton from Trinity College, Cambridge, at the age of forty, describing his studies of the theory of vision.

hiographer, "it occurred to him (Newton) that as the same power by which the apple fell to the ground was not sensibly dimenshed at the greatest distance from the center of the earth to which we can reach . . . it might extend to the moon and retain her in her orbit, in the same manner as it bends into a curve a stone or a cannon ball, when projected in a straight line from the surface of the earth.

"IF THE moon was thus kept in her orbit by gravitation to the earth, ... it was equally probable, he thought, that the planets were kept in their orbits by gravitating towards the sun. Kepler had discovered the great law of the planetary motions, that the squares of their periodic times were as the cubes of their distances from the sun, and hence Newton drew the important conclusion that the force of gravity or attraction by which the planets were retained in their orbits, varied as the square of their distances from the sun.

"knowing the force of gravity at the earth a surface, he was, therefore, led to compare it with the force exhibited in the actual motion of the moon in a circular orbit, but having assumed the distance of the moon at a certain figure, he found that the force by which the moon was drawn from its rectdineal path in a second of time was only 13.9 feet, whereas at the surface of the earth it was 16.1 in a second."

(Continued on page 133)



The professor, trees streaming down his cheeks, buch buside the girl. And there, under the most, the stream story tumbied out in broken English, while Judy bathed Margarat's face

The Movie Maker

A Close-Up of Mechanical Magic Behind the Screen Revealed in This Romance of Courage and Ingenuity

By S. W. NEWMEYER

N KENNEDY, red-bended young director of the comedy Illustrated by Ernest Fukr section of Popular Players' West Coast Studio, and Judy Burke, his script girl, shared the high ambition of some day producing a big feature picture. Toward this goal Judy had written an excellent menano, while Don had invented a new photographic process by which action photographed in a studio might be superimposed on backgrounds taken anywhere by the world, thus effecting enormous economics to production. Jacob Eckstein, president of Popular Players, had promised Don his chance, but just when the young director's hopes seemed about to be realized, they were dashed by news that Popular Players was forced to suspend operations because of financial difficulties. The trouble was due to enormous expenses incurred by the famous but temperamental director, t arieton in filming a gigantic instorical spectacle in the Orient. Eckstein, however, offered to turn the lot" over to Don for six months, rent free provided he would assume also the high-satury contract of Margaret Moreland, a beautiful but lading screen star. Though Don had only a few dofars to his name, he accepted. It was a wind gamble against big odds. Judy offered her acenario and ber services without pay; then induced her brother Jerry, a stant flyer, to join them. That night the three young partners attended the first performance of Margaret Moreland's latest picture, "Frozen Hearts." With them was Professor Mahrlenburg, an eccentric old photographer whom

The picture was a failure—a patiful antichmax to the screen star's brilliant career. The show ended, they saw the star, in disgrace, hurry from the theater and speed away in her sport roadster. Suspicious of her manner, they followed in Jerry's car—out into the country at breakneck speed. At last, near the crest of a hill, Margaret pulled to the side of the road and stopped. Still following, they found her standing on the edge of a declivity. She raised her right arm. Steel gleamed in the moonlight. Jerry leaped from the edge of the road and flung himself upon her. A shot, a sport of flame, and the two strugging figures plunged forward. Now read on

THE got, fighting so desperately for death became a impose weight in Jerry's arms as the feace ripped loose and they toppled forward. With the instruct of an airman, Jerry threw himself and his burden into a side-slip, and they shot along the dirt at the edge of the precipice. As they rocked on the edge, Jerry struggling to turn the balance to safety, strong arms pulled them to the road.

Jerry sat up as Don knelt beside them, but Margaret lay motionless on the road.

"Dead?" gasped Don.



Before the whote background rude Jerry and Margaret, to medieval park. Don took his place at the camera man's chow, "Ready action?" he called through the margaphone to the two

"Not so you'd notice it!" Jerry rubbed has aching side "Only fainted. I knocked the gun out of her hand just as she fired. Better tie her up before she comes to. She s got the manners of a woldcat."

In spate of his remarks, however, he was gently shifting Margaret to a more comfortable position, with Don's aid, when both men were pushed ande and the professor, tears streaming down his checks, knelt beside the unconscious jpri.

And there, under the cold moon, the strange story tumbled out in broken English, while Judy bathed Margaret's face with water from the radiator of her car.

THE thousand dollar-a-week star was the daughter of the penniless and professor! A runaway at aisteen from an English boarding school, Margaretha Mahdenburg, self-christened Margaret Moreland, had refused to be forgiven and taken home like a maighty child when her father had found her in Hollywood two years later. As Don latened, he realized that only a near-tragedy could have brought those two together, so alske were they in their fierce pride.

Jerry, who had disappeared down the road to get his car, now pulled it up become them, and as Don helped the old man and his daughter into it, he felt sure the events of the night had dissolved their bitter stubbornness and reconciled them completely.

Certainly comething had melted the almost haughty reserve for which Margaret Moceland was famous, for as Judy tucked the abandoned ermine cape around her, she leaved against her father, her body occasionally shaken by sobs she could not control. Judy settled herself on Margaret's other side and Jerry drove carefully away, leaving Don to follow in the big racer

Where the road widened, however, Don passed them, and when Jerry's car trundled into the drive of Margaret's home in Beverly Hills, he was waiting there for them, his arms loaded with small hundles.

"Tred to rouse someone," he told Margaret, "but they're

sleeping like the den—like logs," he finished hastily.

"There's no one in the house." Margaret stepped from the car, quiet and composed as usual, but with a new gentleness in her manner. "My servants are out."

"Well, I don't know how you folks feel," remarked Don heartily. "but I'm starved, so I went on to the deleatessen and got the makings of a Dutch funch. How about some hot coffee and a bite to eat?"

Righto'" Jerry took the key from Margaret's hand and spring to the porch. He flung open the door with a fourish. "Opening the Moreland Cafeteria, ladies and gents. Line forms to your right."

Margaret stepped past him, snapping on the lights from room to more as she went through the house to the kitchen. They trooped after her, Jerry and Don keeping up a stream of hvely comments and would-be jokes, none of them very funny but all leading cheer to the coldly alent house.

Judy a even were too busy for her tongue to function. She stared cound-eved at the beauty of Margaret's home—not large, but as exquentely fitted and furnished as a jewel box. Sick damask wall coverings, old rose in the living room, golden brown in the blurary, did blue in the dining room. The intend grand piano in the pale blue and gold music room, where Judy paused for a prolonged peek, must have cost twenty-five thousand dollars, abe estimated.

But the kitchen was a gay little place aluming with Delft blue and white tiles, a porcelain clock like a Dutch plate ticking away on the wall. Margaret enveloped them all in voluminous white aprens and set them to work. Soon the appetizing fragrance of hot coffee innigled with the savory incense rising from a Webli rarebit, and they all crowded around a small table in the breakfast alcove. As Margaret ladled out the thick yellow mixture, she looked up at the professor with a smale.

"FATHER, do you remember the manonette theater you made me one Christmas?"

"One of my happy memories, it is." he replied. "But I now have made you something finer—something that will astonish the critics when they see your next picture!"

Margaret shook her head slowly

"The critics—and my dear friends—will wait a long time before they see my next picture," she remarked in a low tone, "perhaps forever." Purching at length in his portiest, the old professer drew out a long slip of paper and handed it to Doc. It was a cerufied check for twelve thousand datum?



"But no!" exclaimed her father "Have they not notified

you at the studio that Don-"

"Mr. Kennedy must know that I have no feeling against him as a director." Margaret looked across at Don with a friendly smale. "but I'm sure he will understand that I cannot allow my face to be used as a stop for custard pres—even if I am old and passé, as Eckstein told me this morning," she finished briterly.

Eckstein!" mored the old man, pounding the table. "What

does be — "

'Let me explain " Don's voice was quiet, but it had a note of authority that silenced Professor Mahrlenburg. "I want M o Moreland to understand the entire attached before she decides."

Margaret listened attentively, though without enthusiasm while Don outlined Ecostem's terms and conditions. But her attitude began to warm as, aided by Judy he told her of the picture they had planned. When he spoke of the screens designed by the professor to make her look younger. Margaret finshed her father a grateful mode.

"And you have backers?" she asked Don as he finished

NO. HE replied frankly, "and I may not be able to find noy. In fact, without you we have nothing at all but Jobs a story and my invention. I don't even know, now, how I m going to pay your first week's salary—so it might be more profitable for you to hold Eckstein to your present contract, even if you have to sue him.

Margaret looked down thoughtfully at the hoge applure on

her little finger

"If I ame Eckstein," she said slowly, "he will drag the case through the courts, humidiate me—and I've had as much humiliation as I can stand. For months I've been taking powders to put me to sleep at might, but they've lost their effect. Night after night I've lain awake looking at my bfe, watching myself grow old, losing benaty, love even respect. That is why

grow old, losing benaty, love even respect. That is why tought . "She paused the shadow of terror in her even then raised her head galantin and looked at Don. "Tought I thought I had nothing left that the world wanted but if you need me in your picture. Mr. Kennedy, I'll donate this "she drew from her finger the large supplier ring and handed it to him, "and the amount of my salary to the venture"

Judy clapped her hands and Jerry waved his paper napking with a mild harray, but Don, usually the stient serious member of any group, thumped the table with a large spoon and jumped.

to bus feet

"That calls for a speech," he declared. "Tought I almost lost hope for the big picture, but now Miss Moreland's given it

a fighting chance—and we'll fight, the five of us! We'll do thungs they say can't be done, and with just ourselves owning the picture, writing, directing, acting, selling it. we won't have to buck interference from higher-ups. It'll be like the old days of Biograph, twenty years ago, when Griffith himself acted, directed, cranked the camera, shifted scenes, and wrote scenarios, when Mack Sennett carried the camera and played heavies-"

"MARY PICKFORD wrote scenarios, too," changed in Judy, "and acted leads without her name on the program, and brought her family and friends in as extras. Jack and Lottic Pickford, the Gub girls, and "

"And began giving the public what it wanted," interrupted Don, taking the floor again. "That's what we're going to do. Now, here a my scheme for starting the

big picture."

It was dawn when the

three men drove away in Jerry's old car, leaving Judy to finish the might, or rather the day, with Margaret. It had been agreed that all should work without salary, the amount due each to be charged against the picture and deducted from its first profits, the remaining profits to be split equally among them. From the money Jerry had planned to spend for his new airplane, he advanced Don a thousand dollars to pay his and the professor a living expenses during the making of the picture.

Now to must the money for production expenses! Don estimated they would run well over a hundred thousand, in spate of the great economy his universal background device would make possible, for the picture was to be a super-special of the type that often means an outlay of close to a million dollars.

Sunday afternoon the group met again at Margaret's home. This time a sexth and very important individual was added to the conference. "Hose" Biddle, camera man of the unit that had produced "Frozen Hearts." Boso had been Carteton's first camera man until that temperamental director had picked an entirely new company to take across the Atlantic for his big bistorical picture. And all everyone on the lat was aware, Boso was still sore because he had been rejected. He not only knew his lights and lenses, but all the queer corners and beauty spots of the world were charted in his memory, for he had been a new seed photographer many years before being employed by Popular.

Bozo was the man Don had selected to take the camera on a paint through Europe and part of Asia to record the location on the reels, while the cast was to stay at home and do the act ig against blank backgrounds and specially prepared sets. Then Don's nonversal background device would combine the two ii to

a but spectacle picture

All you've got to do." explained Don, "is to carry the camera plenty of film, and a stop watch. Shoot three or four reels in England an old Norman castle that looks pretty much as it did in the twelfth century, a few unles of English countryside without any modern landmarks, a river seem—anything that has ancient atmosphere. Once us plenty of long and medium shots and foregrounds, with a lot of detail such as monts, draw bridges, massive doorways, and out courtivards. And don't forget to take as many stills as possible, interiors especially. We'll need them for our scene painters."

"B! T what's the stop watch for? " asked Bozo, paszled "To keep a record of the exact time you crank each shot, so I can duplicate it here on the lot," Don replied, " and be sure you inclose the time record with each ree!"

Boso was delighted with the assignment. At the railway station next noon Don met him with money for the trip, a detailed script of the scenario, and a long list of (Continued on page 167)

Triumphs of Radio's "Hams"



MACINE a habby so fascinating that it can keep a boy feer his meals—and his father, maste to stop him even by demolishing his radio transmitting set, has to appeal to the Government for and That happened the other day. Eric H. Palmer, of Brooklyn, N. Y., sat down and penned an argent letter to the Federal Radio Communion at Washington, D. C.

'Please revoke my son a locuse to operate his amoteur station 2ATZ,' the father wrote. 'I do not believe he has seen the soulight in three months. He transmits all night sleeps in the daytime, and eats but one meas a day. I believe the boy will die of undernourishment and lack of sleep, and his mother will fall the victim of a nervous breakdown.

Dots and dasoes flashing through the ether this very moment are the conversation of sixteen thousand boys and men throughout the country. Like young Palmer, they have made amateur racho their hobby—if more temperately than he did, no less enthusiastically.

"HAMS" they call themselves. No tame evening spent before a loud-speaker satisfies them. After supper you will find one of them in his attic "racko shack," clicking the key of his homemade transmitter mounted on a deak shelf beside the hissing radiator. His sleeves are rolled up, and head phones are clamped on his ears; as he presses his key he converses with a friend thousands of miles away. Call cards acknowledging the talks are exchanged.

Not every one knows that the radio

Here are a few of their mass news from the polar exploration ship Boudout, wintering at Labrador; an appeal

for help from Vermont, stricken by flood, Army advices from Fort Monmonth. N. J. an America Europe conversation between two "hams, and incidental chata among the several thousand amateurs who were not already busy acading, receiving, and forwarding those messages.

THAT was the meaning of some of those dots and dashes you could have heard on Palmer's short wave length receiver, far below the waves of broadcasting stations. And so the Federal Radio Commission, while it suspended him Palmer, Jr. s beense for ninety days, told him in a letter

America is looking to its 10,000 amateur operators, in which group you stand out, to keep it in the foreground of development. Those of us who were propeers will soon be forced to turn over the reins of radio to you boys, and we want you to be strong and healthy, as the burdens will undoubtedly increase as new avenues for radio are opened by you and your colleagues. This is a marvelous field for the American boy, and such enthuseaum as you have displayed should as a rule be commended rather than discouraged, but in order to develop into a big, strong, healthy hoy you must have regular meals and your full quota of sleep." What part do amateurs play in radio? Independently of all commercial stations, they had the United States and most of the world. They will gladly transmit for you without charge, a message to anyone, anywhere. They keep newspapers informed of what is happening in isolated places, promote world followship by the friendly interchange of messages between continents, and by experiment constantly raise the art and science of radio above the high point where they have already largely helped to place it

the call cards on his wall indicate

WIRES were down in Vermant, not long ago. Through the bracking state flashed a sputtering CQ—"anybody answer."

withur Kent, at Binghamton, N. Y., span has duals by chance to forty meters. "CQ." came a fairt call and Kent sensed his key "8RTO standing by," he shot back. "Go abead."

In a whir of dots and dashes, from Ralph Harris, 18EB, come the first direct news out of Montpelier, it, since the flood hit it—of people marooned on the roofs of houses, Leut.-Governor Jackson dead in Barre, bridges, roads, rails washed out. SBTO acknowledged message after message, some for belp and others to relieve anxiety of relatives,

until one o'clock in the morning, when Harris sent. You are my only contact out of this city. Power off, electric light plant under water the contact hadrenes. Done all we can the essential that messages, forwarded to Washington set in motion the agencies that brought

relief to the stricken area.

Another amsteur, at station 1100\ flashed the first direct news from Barry \(\frac{1}{4}\), another, in Connecticut, but see the only when the water was considered over the top of no table? When city entered away with motor car spark code. A bermont-

amateur's agnals weakened, then came back as 20 UQ. New York City amateur copied them. "Just kicked the batteries out of water on to dry place," was the lacouse explanation. The Army Signal Corps is compiling the names of amateurs who will be officially commended for the part they played in the cross.

IN BLIZZARDS, when are staded and wires down, the radio smateur gets the message through to the disputcher's office. A special radio call, "QRR," is the rangood Ses.

When a tornulo raged down on Mary lysboro, Ill., an emergency call appealed to C. B. Harrison, operator of the only radio transmitter near by. Up into the forbidden wave channels of broadcasting stations the amateur tuned his wave. Every latener heard a ghostly voice break into the evening program giving news of the calamity and urging doctors and nurses to board a rebef train on its way to the steaken town. How that train, jammed with workers, brought relief to straken Murphysboro is now history.

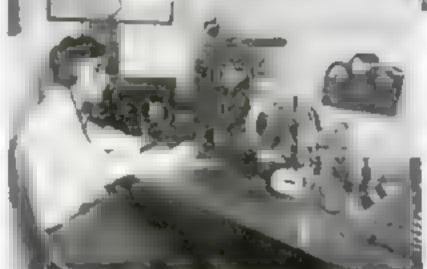
During the M-fated Dole flights from California to Honobiki last summer an amuteur "tie-up of local stations flashed last minute news between Hawan and the mainland. And through the modern miracle of the "ham a" short waves be has rendered a service that is exclusively his keeping the world in bouch with

existorens.

Donald Cadrow, ethnologist. of the Putnam Buffin Island Exped tion on the schooner Receion flashed a radiogram from point seas to amateur station BDNE, Aubura, N. Y., to give the first news of Arctic decoveries that change the map of North America. ' Persons! niessages from home the expurer said, "were flashed over the mountains and rec fields to the expedit on by Charles Heiser's radio station, Agenra, in an theathy way. when even the greatest stations of the empatry could not be neard. They gave the explacers the novel experience of reporting their discoveries minate by minute and recessing radioed congratulations from



The many transportation and XN Arriver and The form of the form of the first the form of t



This amateur station looks crisis enough in comparison with that above, but with such apparatus radio "hara" have guided the earth

bome. What a contrast to the old days of months-long treks with dog teams to carry news to the nearest outpost?

Thousands of personal messages are sped on their way over the "hams" carefully worked out "traffic routes" through stations all over the country.

THEIR call letters, such as tBEB and BINE, are assigned by the Supervisite of Licenses. The number that precedes the radio call letters designates in which of the nine radio districts of the constry the amateur station is operating.

In national caretgenes such as war, the "hams will instantly place themselves at the disposal of the Government with a reserve communication chain of inestimable importance. The Navy Department has disclosed place to organize expert amateurs of the Eastern district for training in handling Navy

messages. In a year the Army, which would be to be achieved. I as achieved 15 000 messages. I was a port Maria N. J.

The world is a lettle too and I for remomentation, any "ham" will sel-William. A M. kay, distings shid No. York mural pointer, converses regularly with a friend in Cape Town. South Africa G. F. Caesle, of Paterson, N. J. recently picked up a message from Laberia and, notifying the U. S. Department of State, sent back its official greetings. Many American "hams" belong to the "WAC Club." composed of those who have "worked" all continents.

Let your mind wander back to July, 1914, when the boy fortunate enough to have a "wireless set" communiced awa from his acquaintinees, and no one dreamed that more than 5000 new anateurs a year would be applying for laceuses by 1928.

COLUMN DY 1945,

THAT month came an important amounteement. The American Radio Relay League was being organized under the auspices of the Hariforth. Came, Radio Club. This league, now the back bone of organized amateur radio offected the cuttre series of epoch-making tests that led to trans-Atlantic amateur radio and greater conquests.

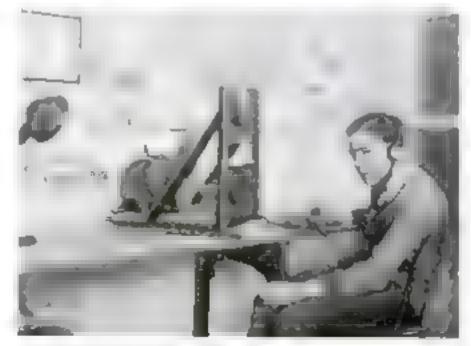
Wireless farm rushed to join the League, and before long a new language had

sprung up—a curious, abbrevasted code. You might be pussled by this sample

"Ur sign QSA OM fb., hw do u lik mi spk?... tt s
gd cuming fm u... sounds
bk mi Manngang la C... hi
... sa coda i u drop er s im
nite es wk siem DA wit me?
tomte? ... col ... best

When translated this be-

'Your signals are coming in strong here out man fine business' How do like my spark' That's good coming from you—sounds like my young lady friend singing high C (laugh). Say, couldn't you drop in some night and talk to some distant stations with me? (Contensed on page 141)



Eric R Palmer Jr Brooklys. N Y., boy amateur radio operator whose license was suspended for 90 days so he could get some sleep and meals



TO LET the ocean waves do the work of nun by providmg hydroelectric power, Lieutcuant Commander Lybrand South, of the Navy Depart ment's Bureau of Engineering, has designed an amazingly in-

genious battery of hydraulic rams, illustested by the schematic drawing and the accompanying diagrams.

The drive of the waves into the great funnels forces the water through pipes up the chiff into the long flume along the

Sea Waves to Drive arranged that the water forced into them by each successive wave does not fall back when the wave s strength is spent but

edge of the cliff. This flume carries the water into the reservoir, from which the accumulated water pours down larger pipes with sufficient force to operate the generaccing machinery in the power house below

The hydraulie rams operate bydraube

jacks which are simply valves so is locked in to remain until more water is forced in by the next

wave. Each valve, like a door that opens. but one way, is pushed open by the water's force. When the force is exhausted the weight of the water closes the valve, holding it shut until the next wave presses hard enough to open it.



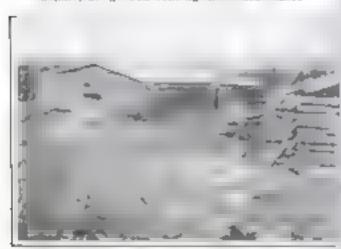
Provide the state of the state

The World's Greatest Timber Crop

Amazing Machines Help Glean 150,000 Cords a Year on Strange Island



A v_a where one are an expension for the second of the se



In camps of this so whe has men as he under take are taken we make the we have set top to the are taken we have set top to the her better the here of the heave the many mental party by a sput rolly by foother regularish the return who has a ways soft end for many weeks. Righ Construction work to prevent Port Man et also was turn at he he his,000 costs of week on mand in the retaining has in







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ON THE little forest-covered pland of Antico I plane no the The St Lawrence It is the forgest burnering operation is the world for pay is forming to bolish supplying a second colof pulpowed a year to Anni my melous. Three stating over to anywhere

Or H Courses long his firsty wide this island contains now to \$5,000,000 earth of polywood.

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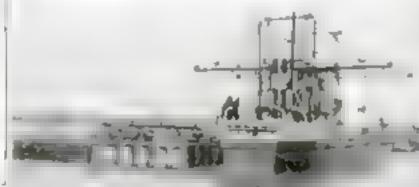
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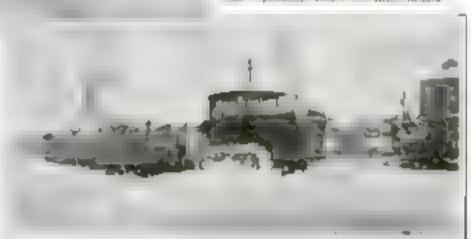
The processed support support of the set of



The angles shown sample in the common shows a same of the process of the process of the common shown in th



Unusually built pier at Port Menier, where work goes on the year round to improve and astend facilities to hervest the 12,000,000 or 15,000,000 conduct pulpwood and one of the inhead's peculiar ships used for this work



One of the powerful caterpillat tracture that had trains of sleds loaded with pulpwood through the soons of Antirutti. These markines make it possible to do some burvesting of the wood even during the writter time



One of the battlesh ps on wheels with its rrew, photographed after its assembling at St. Nazaire. France, just before it left for the front to hur? 1400 pound shells

Our Battleships on Wheels

How American Navy, Firing "Off the Map" Shattered and Set Aflame Germany's Vital Rail Genters, Hastening Victory

By REAR ADMIRAL CHARLES P. PLUNKETT, U.S. N.

In Collaboration with THOMAS M. JOHNSON

N THE war map you stuck pins in tru years ago, Laon was northeast of Sossons, with so many radiating nulroads that it looked like a spider from No. I cut off the spider's legs at right days' bombardment, though news came at the end of the first day that the tierman retreat from before Later was commencing.

That was September 28, and we had just given the Germans a continuous performance from 1:00 until 5:30 in the afternoon. We only stopped then because it was dark and they could easily locate in by the great flash the gun made. We had dropped forty-seven fourteen inch shells at 34,320 yards on their railroad subugs about one every ax minutes. On September 80 we commenced at 11.57, fired five abots, knocked off for dinner, and between 2:36 and 5:27 fired twenty five more. Enemy applanes came over, looking for our exact position.

NONDER. Nothing so big as our shells had ever before burst in their midst

On October 1 the Germans threw more shells into St. Christophic cometery. We squared up next day by dropping thirty on the Laon west railroad.

We had hooked up our telephone to a French sausage balloon and on October 3 we began firing with airplane observaIn this, the third and final part of the amosing story of the American Novy's long-range guns that helped turn the tide of World War battle against the terman, Admiral Plankett, who commanded the guns, and Mr. Johnson, who so a war correspondent watched their campaign, reach a smasking climax.

tion. We fired ten shots, and the observer saw six land, two on the inditary railroad we were after. We know that meant a tie-up on the subway for the Germans, so at 6.50 we knocked off, having thrown nine more shells after correction by the observer's reports. Next morning German shells landed between us and Sommons. We sent the ammunition cars into safe retirement.

ONOCTOBER a the Germans cracked down on us hot and heavy in the afternoon, and again in the evening. One shell struck sixteen feet from the gun, and fragments cut the train air line and broke off a piece of casting. One struck a clothes bucket in which a gob had been doing his washing. We sent the men back out of danger and moved the gun back. The Germans, maxware, opened up again in the evening on our old position.

The total damage was ail, but next time we might not be so fucky. We dug boles for ourselves, and made dugouts near the gun to hold fifty men. Our battleships on wheels deew a lot of attention. Allied officers were continually inspecting them and military visitors bothered our firing initial we had to build a rope fence around the gun. American Congressment staited as, and one wrote his name on a shell before it was fired. Our most delightful and delighted visitors were French and American nurses from a hospital at Villers-Cotterets that the Germans were bombing, who came to see us get even.

OltR two gum fired every clear day and some that weren't. Gun 1 on the Laon railroads. Gun 2 on Mortiers, antil at dinner time October 12 the French sent word their infantry were entering Laon. To see the effect of our shelling, Ensign Roger tilen and I followed on October 14

It was easy to tell where our shells had int. No other shell holes were so large and deep as ours, which averaged forty to seventy feet across, and in some we found fragments that we recognized. We found the nose of one shell three in les from where the shell had exploded. One lat was enough to wreck a three-track railroad line for at least 100 feet blowing an enormous crater in the roadbed. Although the Germana had repaired the damage at hight, their use of the railroads had been greatly curtailed. A freight, train was on a siding just as it

had been struck, one car thrown on top of another, a third thrown thirty feet. Three shells had wrecked completely a storehouse used for electrical material.

The French people told us that the Germans had a large moving picture theater in Laon, always crowded with soldiers. One shell struck it. Forty Germans were killed and sixty severely wounded.

We found that when we had fired "off the map," shots were almost always effective hits, but where we had airplane observation and applied corrections, later abots were perfectly placed. We had airplane observation on only about ten percent of the 782 shots we fired in Fearce. The fall of only twenty-three of Coin 1's 198 shots could be observed many more shots called "unobserved" were fired following corrections and these were usually direct hits.

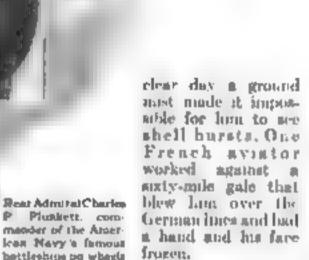
SHORTAGE of aircraft or necessity of firing on cloudy days were the usual reasons for firing off the map. And an observation aviator up 5000 or 6000 feet and his troubles. Not only did

German antimicraft articlery and fighting planes make special offert to get him, but often or, a seemingly





One of the dugouts that sheltered American pulse in France from the assurcing shells of the Germans while the Americans were srecking enemy railroads with the biggest game that France bad over seen on land. This artifliery duel lasted more than a month, when the war ended



Firing off the map is not hard for anyone who has been a navigator. We considered the problem a dead reckning course and distance calculation. We used only a map showing the vicinity of the gun position and another showing that of the target position.

TO OVERCOME the difficulty of representing a spherical surface like the earth on such image a projection called the "Lambert projection" was used to give a correction applied to astronomical observations of our or stars or of polarishs theodolite, to obtain a "Lambert bearing"; by the a travense could be run over the gun aight to orient the gun according to the Lambert system. Lonwooldn't think you would have to take solar conservations before you could shoot up Germans, sounds like astro-

Another carious thing about our battle-ship on wheels was that we got weather reports radioed frespontly from stations along the front. These gave in rode caro metric pressure, temperature, force of ballistic wind, its direction, and height of observing station. They got wind direction by watching small free badoots use and drift. At night the balloons were loaded with powder, set to explode at different heights, and their positions in the air determined by sound ranging. That is one of many illustrations of the complicated and scientific procedure of firing long range guns.

Of course, to fice a 1400-pound shell as far an 48,000 yards at something you can't see, going up \$5,000 feet into atmospheric conditions that must be largely guessed, is a real task. But mirrordously,

we found the range error averaged only 151 yards and the deflection error only fifty-one, and, as most of our targets, such as radroad yards and amountion dumps, were of great extent, and as one gun fired as many as fifty shots in one day, we believed we had worked out a method of scattering shots an as to do the greatest possible damage. Commander Schuyler has suggested that a mathematician might discover how long-range guns without observation can do the greatest damage. That would be

In a minute or two there was a dealening crash as every French gun for miles, it seemed, burst into action. For perhaps a half hour they fired continuously, the general meantime talking on about other things. He only nodded when a second note told him a strong German counter-attack had been repulsed.

AS SOON on General Perstung heard that we had definitely succeeded, he sent for us to help win the biggest battle in American history and the last days of

we had learned, to carry a second "feet" of five guns to France. Before they got there the war was over.

Our guns were in at the death. Under the hammer blows of all the Allied armies, the Germans were retreating slowly from Belgum and Northern France. The pivot of their retreat was the Meuse-Argonne region north of Verdua, where the Americans were attacking. Here General Peraking was trying to reach a web of railroads of vital importance to all the German armys.

These lines connected the Rhine and Germany with the front in France by way of Metz, Montmedy and Sedan, all big rudroad depots. Mont-

railroad depots. Montmedy had a large railroad
yard usually filled with
cars. It was on the main
line from Mets to Sedan
It was headquarters of the
German Seventh Army.
All the railroads in the
locality were part of the
German solar plexus and
you couldn't cut one
without making trouble
for all. Our secret field
orders from Brigadier
General William Chamberlains, the American
heavy artillery comman-

der, said.

"The towns of Montmedy, Longuyon, Spincourt and Continue-en-Jarny are among the most important railroad conters of the enemy's transportation system for the supply of the Western Front.

"A GROUP of long-range guns more powerful than beretofore assembled for a single operation in now being emplaced to attack the above centers."

So we started out to do it. The place selected was the brarest point on the front to Longuyon and Montmedy, where they had built the curved tracks from which our guos tred. At Thervide, two miles northwest of Verdun and at Charny, three unless north of

Therville, both rather hidden among the beights of the Meure, were our positions.

The first guns to get there and join the traction Army in battle were Numbers 1. I and 5, which came up from Harmont without many Jonans for their first trip to any front. Pits were dug at Therville and Charny for guns I and t. en route.

The same day that I was counting the big boles bun I had made around Laon, town 3, 4 and 5 were digging their pits at Therville, searly 100 miles southeast. A couple of days later the Germans gave the valage such a shelping that Lieut.

J. R. Hayden took fifty cans of powder in out of the wet and put them in a bombproof.

At 12 22 on October 21 Gun 3 fired the first shot, and just one hour later six German airplanes were flying overhead, and about 4:30 seven shells fell near the gun.

On October 23 Guns 4 and 5 fired one abot each, ranging on Longuyon at about 38,500 yards, and (Continued on page 153)



Bornelling worth knowing in the next was

In the last one we marked off about 400 meters be worted for the state cdge and 400 by fore the far edge of the target, then drew lines 文마) meters fande the right and left edges William that meen we drew is we rail on which we ruses y use panel for such much to be fred parting man h The palage I be a terwould carriage easily had to lide or one of ti se points L worked so well that General Mangin was well pleased.

The headquarters of this celebrated French general were only a few hundred yards

from one of our gun positions. Once I was at dinner there when an orderly brought a note and the General and his Chief of Staff went into the next room where the maps were. When they returned, the General remarked:

"Well. Admiral, you have been making a good deal of noise with your guns. Now it is my turn to make some."

Top photograph. One of the American mayal game that belyed make German retrest almost a rout, wereling redroads, ammumition stores and headquarters. Middle Pit and foundation under gus that permitted maximum elevation and range of 42,000 yards with old shells, nearly 50,000 with new which never reached France. Bottom louding ammunition car. Drawings show a benthing car and the sheltering of a trainions. Once I October saw our highest amhitton realized.

october saw our highest ambition realized call five of our battleships on wheels assembled in a "fleet" under immediate command of myself, an American admiral, working with the American Army to win the war. Another proof that we had made good was an order to the Navy designers in Washington to commence planning a new gun car, using the lessons

Robbing Fog of Its Perils



Commodors Harrivy. Leviether a mastertairing to bearings with radio compass He rotates the entenna long above deck until signals from the beacon are weakert. Then the loricating device shows also a saset position

E WERE pearing the American coast in a fog which had blanketed us a good part of the way across the Atlantic For three days our slip had barely crept,

continued y sound of its properties. Now a chorus of whatles from other craft indicated we were in the vicinity of New York harbor. But where?

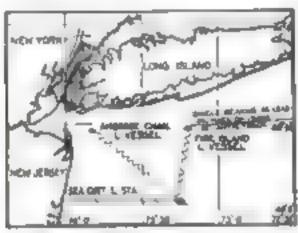
The engines stopped, anchors went overboard, and for eightcen hours the big liner lay there, afraid to move.

"I don't know just where we are," the sk pper explained." But we ve gone as far as I m willing to go in this per soop.

That was less than ten years ago.

Recently I was bound from Bordeaux to New York on another ship—and in a Waves of Radio and of Light and Sound Guide Planes and Steamships Through Blinding Vapor

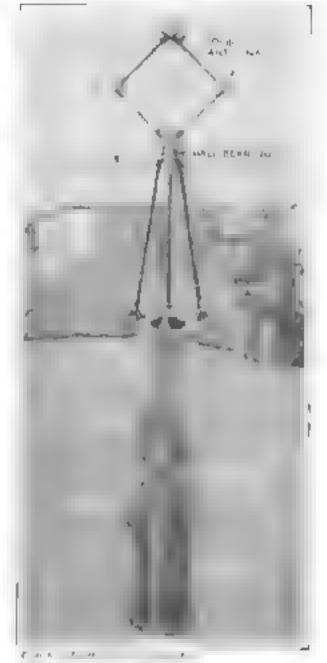
> By NORMAN C. McLOUD



Eachange of radio signals by liners with light ship and light station and with each other above their punitions and guide them into part

fog an thick. Yet as we approached Nantucket Shouls there was no lessening of speed. When I sought an explanation, the skipper, a seasoned Scot, invited me into the chart room. "That's the answer," he said, pointing to two colored pened dots touching each other on the chart of our run. They indicated the ship's position.

"We had a glimper of a few stars just before daylight," he explained. "That's where we got the blue dot. About the same time we picked up direction signals



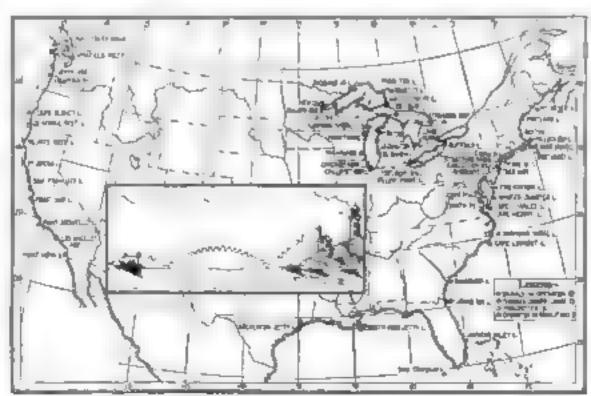
The "care" of the callo compass—the ball bearing rotatable toop antenna mounted ma deck and controlled from the pilot home by a shaft. The loop consists of a number of turns of were inclosed in water tight tubes

from a coast radio beacon. That's where the red one came from. You see, we can't go far wrong."

In those merging dots was written a remarkable story of the use of waves of

radio, light, and sound to bansh within the last decade much of the old terror of fog at sea, on land and in the

Newest of these triumphs are the radio braçon and radio compass. Radio bencess of the U. S. Lagothouse Service radiate wireless signals, and a angle beacon enaides the navigator to steer a safe course, even when fog completely abuta off visibility. Signess from two or more brarons in divergent directions enable him to chart his position accurately by tripingulation of cross bearings. Moreover, the compass will tell him the



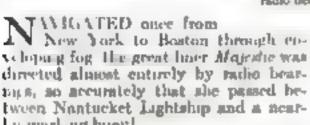
Dots show 59 radio beacons of U S. Lighthouse Service, whose operation the sketch illustrates. Of these 43 are in operation, 3 operate on request only and 13 are under construction

location of another vessel Indden in fog, by determining the direction of her

wireless signals.

Along the Atlantic and Pacific coasts, the Gulf of Memos and the Great Lakes. I nele Sam now maintains mere than forty radio beacon stations. Constwise steamest never are out of their range.

Recently, for example, a veteran a apmaster, Capt. Frederick W. Jones of the U. S. Shipping Board, guided entirely by radio compass, took his alup safely from Delaware Breakwater to Buston—all the way through licavy fog-though his route lay along Nantucket Shouls ni il around Cape Cod reefs where many a vessel has come to grief.



Ly marking buoy!

Most large ships now are equipped with a ratho compani, which is used con-Levally not only to take hearings but to nvest collations. In heavy fog off the Lacrife count the ateams in H - FIt rander not long ago picked up the wireless signals of the steamer Asses a slower vessel showing the I - o directly alread. Thus as a rest two) straces, a desistrons (c. iii sus accerted.

The radio beginning with repupage of so hathe same as that for ordinary were har thuaca sejon and days atgrade and a restorably at regular intervals by a motor. s riven mechanismi. Encli benenti liaci i s ewa identalying argust on certain maple com aration of dots and dashes of the Morse cone

The navigator redutes the local action of his radio compass until the services strong enough to establish to establish of the actoling stations. He has been a loop again to the point where the og ids.



For ever the mountain range to longer terribes the aviator, for signals from radio bencome sell ham if he is no his course or if he is at the seft or right of α

are weakest. At this point, which is more sharply defined than that of maximum intensity, the plane of the loop is exactly at right angles to the direction of the beacon. An indicator on the instrument shows at a glance the direction with relation to the magnetic compass.

RADIO dramatically proved its worth as a guide during the flight of Amundsen's dingible Norge across the North Pole two num-

race ago. Hearings





A fog bank rolling in on the sea to test the powers of modern science in guiding shipping. Above: Cosst Guardsmen burning flares on the Massachusetts court to aid in making rescues from a ship. wrecked in a dense fog. In emergencies primative methods still often serve. Seven men were saved

lost in a thick fog, the slip was in grave peril when its radio compans packed up signats from the wireless station at Nome, Aleska, turning possible disaster into an epoch-making achievement.

THE Government's present program calls for radio beacons at 200-mile intervals along the country's main routes. Unlike the maring beacons, however, these send out directed beams of radio arguals, like the beam of a geardlight, along the course to be traversed. For an air pilot to follow the path of the beam is supply a matter of interpretting Morae code aignala. If the plane is on its course, the nighal to the ningle dash of the letter T. If the course us to the right, the menal ne-

comes the dash dot representing the letter N. If to the left, it becomes the dut

dash of A.

An elaboration of this system, recently introduced along the Government or mail toute between New Brimswick, N. J., and Cleveland, O., combines the radio beacon with radio telephone facilities for the pilot. Not only is he guided, but he reports his position by telephone every five minutes. Another improve-

ment, developed by the Radio Research Ikeard of Great Britain, is a device which translates the radio waves from a beacon. into hight waves that are visible on the fluorescent, screen of an osciolograph in the priot a calcu.

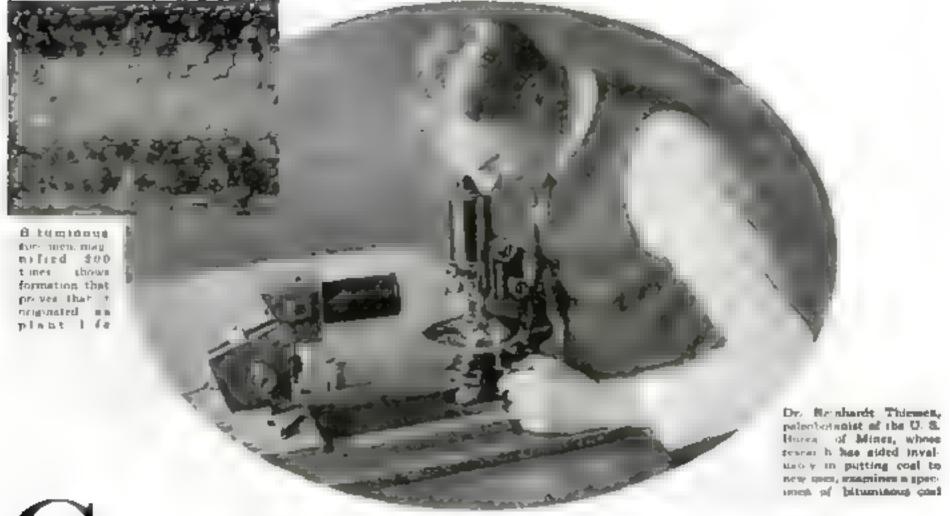
FREDERICK A Kolster, inventor of the radio compares, has gone has own device one better with a marale radio bearon." This netually is a "radio foghers" for stips, in the form of a low power automatic ra-

the transmitter which sends out a charactenstie sigi al nudible for ten miles.

Of lafe, however, inventors have greatly mercased the efficiency of autible fog wareness. One important advance is in the transmission of sound under water, where it travels with much less variation than in the air. Many submarine bells have been matailed along our coasts. Slops pick up the submarine signals by means of microphones, placed below the water

Light mgnals, likewise, have been greatly improved. A powerful new ray which penetrates dense fog is supplied from vacuum tubes by neon gas.

To safeguard the passage of vessels through rock ribbed channels, underwater beacons have been developed. These consist of submerged searchlights powerful enough to reveal hidden pends no matter how dense the fog.



Coal Too Useful to Burn

Chemists Already Make Bituminous into Medicines, Dyes and Fertilizers and May Make Tile and Rubber

By A. C. FIFLDNER Chief Chemist, U. S. Bureau of Mine

VERYONE who has tried to keep clean in any neighborhood when noft cont was burned will be sitterested to know that research chemists in the Pittaburgh Experimental Station of the U.S. Bureau of Mines are hosy at the present moment, making it aniokeless. Literally, they are knocking the tar out of it!

More important, in so doing they are

discovering new ways to change the smoke into valuable new products that everybody can use. Already -and their work has just begun-they have found how to extract from coal tara valuable material for preservation of wood and excelent antiknock fuel for antioniobian.

The experiments are but an indication of how seventific research is swiftly revolutionising the world a use of coal resources, and thus changing the whole face of industry

At present, of the 578 million tons of bituminous mined annually in the United States, Busety percent is burned for heat, light and power, without Courses of Carnets Section of Technology recovering any of its preclous by products. The

other ten percent is converted into gas and coke. From two thirds of this other by products such as tar, ammonia, and light oils are recovered

AT THE present rate of progress, however, we may expect to see the ratio reversed before many years. Com-paratively little coal will be shoveled into the fire. It will be deemed too valu-

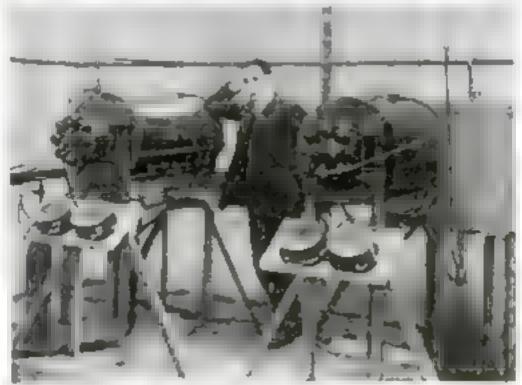
able as raw stuff for the manufacture of vital necessaries of life, as well as a source of more efficient fuels. Even now the list of everyday things derived from coal runs into the hundreds, includtog dyea, fertilizent, explosives like TNT, medicines, drugs, solvents and preserve-

It took about a lifetime to build up Germany a great coal tar dye industry,

> based on hy-products of coke manufacture. But, thanks to modern research laboratories, it required only a few years for Germany to develop the commercial manufacture of wood alcohol from watergas a product of coal and water-to the point where it rang the death knell of the great wood-distribution industry

AND American chemyears, developed a process of their own which is now operating at Belle, West Virginia, in the heart of the betummous field. Plans are being mude to enlarge this plant to supply the entire American yearly demand of ten million gallons!

(Continued on page 164)



Making methanol from coal and gas by the Petart method. Under pressure and heat in cylinders zinc and chromium compounds change water-gas to wood alcohol



This is no nighteners, but a German health exhibit calculated to impress forever on people's minds the importance of maintaining correct posture. The skeletons are shown in the correct and incorrect attitudes for daily human activities at work as well as at play

Newest Harvest of Research

Skull of California" Ape Man" May Be Half Million Years Old— Heart's Electricity Photographed—"Death" of the Sun Predicted

Adequare in many and scalely diverse fields of scientific research, discoveries, inventions and theories, important because of their bearing on everyday life, are chronicled such month in these pages.

Sun's Collapse Predicted

A GREAT British astronomer Professor J. H. Jeans, save the sun is ready to collapse at any moment. When it does the earth will be frozen so cold popody can live on it.

A French astronomer M. F. Baldet, finds evidence that the planet Jupiter, largest in the sun's family, is shooting enormous volcame bombs into space. Some of the comets and fire bala that sometimes but the earth may come from Jupiter.

In our own universe of the Milky Way, and in countless others like it, such bombardments signatize momentous changes as time moves on

Of the many stars in our universe system possibly therty billion modern reflecting telescopes are capable of photographing three billion. Each is a son. Most of them are larger and brighter than ours. Each sheds energy until it burns out. Stars at old age, called "white dwarfs," give little heat and light.



To determine the effect of wind on buildings, this and other models of skyscrapers are subserted to arraftend burracenes in a wind tunnel by the U.S. Bureau of Standards, as described in the February Populag Science Monroery. By varying the presence on various parts of the structure it is possible to find where it is too weak and where sunnecessarily strong. The tests are arrabable to builden

Professor Jeans calculates that our sun is persionally near the "white dwarf stage. Any day it may toller But, since a day in the impressional be millions of years, this is nothing to worry about

America Man's Birthplace?

WORKMEN, laying a sewer in Santa Barbara, Cabi, fourd a skull buried eighteen feet a few weeks To them it was only a somewhat gruesome mass of bone, but to Dr A. H. Ousdal, an archeologist, it was a rare historic document. For his examination indirated, he said, that the skull was the nearest thing so for found to the 'massing link' connecting man and the apes with common ancested Undoubtedly he and, it is older than the skull of the famous Java ape man believed to have lived nearly half a mulion years ago. The primitive ape man who possessed it could not have been able to speak except in grants.

If Dr Ousdal is right and there seems excellent reason to believe that he is the find will add important weight to the theory recently advanced, that the turbplace of the human race was in

the New World.

Oil Engine and Cheap Helium May Start New Flying Epoch

AVIATION engineers of England have perfected a new airplant engine of the Dresel type, which burns heavy oil in place of gasoline

From the Fixed Nitrogen Laboratory at Washington, D. C., comes the statement of Dr. Frederick G. Cottrell, expert on the chemistry of the atmosphere, that helium gas may be obtainable from the mr in included quantities.

These two recent developments have an important bearing on the advance of

aerial transportation.

A soccessful nomultammable oil engine will remove the fear of fire that now stands in the way of public confidence in flying. The new engine delivers less power than a gasoline motor, but also reduces fuel consumption.

An unfuncted supply of noninflammable belians for the safe inflation of amilips would remove the most aerious handicap to development of lighter than-air craft. In ordinary atmosphere there is only one part of beliam to 180,000 parts of air.

But there is plenty of air.

CAMERA, a cut.

A a buildog and a

nursery of babies were

assembled recently

in the payelsological

laboratories of Johns

Hopking University to determina what nort of stride babies

use when they creep. The answer was.

eamers, the est and

the dog proved to be

Battles are trotters. Watched by the

pacers, the weight of the body being alternately borne by the two legs on each side. The habies, however, in almost every instance kept their weight balanced diagonally between a leg on one sale and an arm on the other, in the manner of true trotters.

Dr. Lenorr H. Burnside found that usually the first attempts at lowmotion consist of Bounderings said waving of arms or lega. Later the baby a arms begin to work alternately while the legs are still dragged. At last the infant ruses his body and strikes out in a trot.

Photos of Heart Electricity

PHOTOGR APHY'S latest achievement, announced by Dr. C. E. Kenneth Mees, Director of Research in the Eastman Laboratories, is in recording faint electric currents of the human heart! The process, employing a strong galvanometer, a delicate instrument for measuring electric currents, promues usefulness in diagnoung beart ailments.



light waves so that they may see what they eay and improve their prticulation. The pound traves, striking the secrives displangue, set up tiny currents in an electric circuit, which causes beams of light. reflected through murves, to represent the sounds exactly as they were aftered



Only by wearing open-weave fabrics can you get appreciable benefits from the sun's bitra-violet rays, according to much made by this device recently in the U. S. Sureau of Standards. Only coys passing through the meshes have sufficient healthful action. The solid part lets through only five to ten percent. Dyed and aged thread let through the least, says R. Stair, who is pictured making tests on various samples in the Bureau's laboratories

Accidents Due to Blood

HE reason some auto drivers constantly have accidenta whise others have little trouble may be largely a matter of blood pressure.

Dr. Walter V. Bingham and C. S. Slocombe, psychologists of the Personnel Research Federation, New York City, have just completed experiments in which they find a definite relation between bealth and motor accidents. Among bus drivers and motormen more than fifty years old, men with high blood pressure were found to have more than twice as many accideals as those with normal pressure.

This excessive pressure, the psychologists say, apparently affects health and temperament to a point where it interferes with sale driving. Their investigations also showed that the longer a man drives the fewer accidents be has.



The towering new tobecco plant developed by Professors T. H. Gondepsed Tells and A. R. Olson of the University of California by the action of X-rays on sex cells of the parent plant from which the giant was produced. The compose tobacco plant is shown between them. Their experiments confirm those of Prof. H. J. Muller, noted in this magazine last growth

Mummies Sought in Arctic

MUMMIES of long forgotten men of the Far North, older than those found in ancient Egyptian tombs, will be sought by an expedition of the American Museum of Natural History, this spring, exploring the Arctic Coast of Siberia.

The remains are those of printive Mongoliana, believed to have been the first settlers of North America. Their existence was reported by the late Dr. William H. Dall of the Santhagatan Institution. For thousands of years they have been preserved by Nature in caves in the Aleitian Islands, where they were buried. They are believed to date to the posigiacial period.

Natives of the Alcutian Islands believe the my minues hold a curie, and fear to go near them. It is related that a Swedish fisherman who attempted to remove a mummy to the United States in a boat was never heard of after he set ead.

This year's expedition is led by Harold McCracken, who has spent five years in the Arctic.

Insects Turned into Metal

SOME months ago a German chemist, Dr. N. D. Zelmaky, was making chemical analysis of certain maects. The process involved covering them with powdered copper oxide and heating them in small platinum crucibles in an atmosphere of carbon dioxide. He was automaked to discover that the insects turned to metal. with the delicate markings and structure preserved. As a result, museums may preserve rare specimens indefinitely.



"Road Yacht" Complete Home

Till man who drives with one hand will find that he may use the other to reach for a sandwich and a cup of coffee in a "road yacht" developed in London.

The vehicle, which looks like a large metal bug on wheels, as the latest in touring layary. Speed of forty-five miles an hour may be easily attained. An electric "galley," completely fitted layatory, two alcoung cabins, book shelves, writing tables, and a radio complete the enorpment of this automotive innovation, which accommodates five persons

Big New Meteorite Studied

WHAT is thought to be the largest melecule preserved intact for which the date of full is definitely known is being studied by experts at the University of lows. It is a 110-pound chip from a celestial visitor that exploded about ofteen miles above Iowa City, In., according to Prof Charles C. Wylie, one of the investigators. The chip buried itself in hard clay.

Bottle Traces Ocean Current

A floating bottle's journeys ended the other day when William Hannapia walking along the west coast of Ireland, picked it from the water and read the note it contained, "No. 1059. Please return to William Beebe, New York Zoologiesi Park, or to the Hydrographic Bureau, Washington, "Nearly a year ago the noted explorer Beebe had thrown the bottle into the Cambbean sea 2800 notes away the Gulf Stream had carried it to its journey's end.

More than a thousand such bottles were dropped by Beebe during this cruise. Thirty-one were recovered, mostly from Central American shores, but this one revealed caprices of ocean streams.

How to Name a New Animal

IT'S harder to name a new asumal than a new buby, according to Dr. C. W. Stilet, secretary of an international commission that has sought for years to work out a standard naming procedure. The creature runs the risk of being named several times by independent discoverers.

According to the communion, if you discover a new species of bird, beast, or butterfly, you must publish the news of your discovery and give it whatever technical Latin name you wish. This alone, rules the communion, is the name by which it will always be known. Communion with 1931, you must not only same it, but also describe it so fully that no other species may be mustaken for it.

Nearly half a million species of animals have been named since the pioneer studies of the great naturalist Linnaeus, anys Dr Stiles.

Saw Uses Sand to Cut Rock

A long steel cable, drawn at high speed and fed continually with wet sand, cuts through solid rock in a new type of quarry saw developed by Dr Oliver Bowles, of the U. S. Bureau of Mines. Tiny grains of sand, dragged across the rock face, serve as abeauves to groove it at a rate hitherto unknown. In Pennsylvania, quarries the device, known as a wire saw cut quantities of took without need of the coether methods of drilling, blasting, and cutting.

Swastika May Trace Races To Lost Pacific Continent

MANY thousands of years ago there stood in the Pacific Ocean a continent where thrived a remarkable civilisation. In a tremendous earth upheaval the continent variabled, availowed by the waters. But before the catastrophe, adventurers from that lost land drifted to other continents and left their marks.

Such a the fascinating theory advanced by Col James Churchward, of India to explain the origin of mysterious symbols found curved and painted on rocks.

Most famous of the symbols is the swastika cross found on rocks in America. Asia. Europe and Africa. In North America the rock writings, or petrographs, have been generally attributed to comparatively recent tribes of Indians. Colonel Churchward, however, contends that many of them are very ancient, and that their original source was the lost continent. With the aid of key symbols discovered in India, he claims ability to translate some of the mysterious writings.

Interest in tracing the family tree of modern man has been heightened by the recent statement of Dr. Ales Hrdicks, noted anthropologist, that the low-browed grisly Neanderthal man, who lived some 40,000 years ago, may have been our direct ancestor, instead of a dutant count of a different species. The belief has been that this prelimtoric race was exterminated by the later Cro-Magnon men and left no descendants. In the remains of Neanderthal man, however, Doctor Brdicks finds new evidence that he formed a definite link in the long chain of human evolution.

Motorcycle Drives Sea Sled

HOW would you like to go for a motorlum, pictured below, thinks river cycling a plausible idea even though his first attempt to cross the Thomes resulted in the sinking of his queer much be and the account forced little better. His vehicle consists of a motorcycle built into a float of the sea sied type.



With a motorcycle built into a sea sied. R. A. Cullum has a remarkable water craft, which runs on tranqual puringes, but the Raginhanan's efforts to cross the Thomas Rayer have so far been unsuccessful

Gear-Wheeled Roller Skates

SKATES like those seen below would allow you to drink that extra cup of coffee and still get to work with time to space, for the remarkable speed of thirty railes on hour is claimed for them. The effective motive power for these up-to-date "seven-league boots" is furnished by the downward step of the skater through a ratchet gear wheel. Springs that operate automatically return the carriage to the original position ready for the skater's next stude.

The name of "walking machinery" was given to the skates when they were shown at the International Inventorial Extubition at London. The novel skates proved to be one of the most popular of the many interesting exhibits.

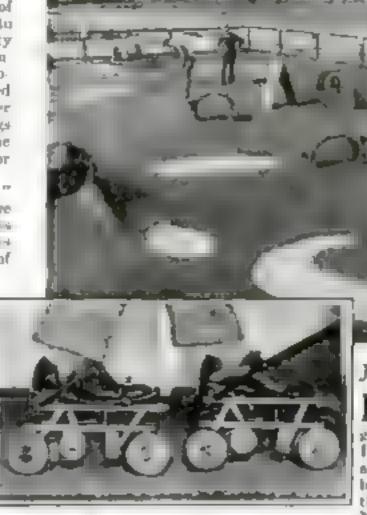
Self-Sprinkling Roads

Clay roads are kept most, firmly classic, and free from sun-dried cracks in Michigan by the addition to the clay used in building them of an odd chemical that absorbe water from the air. The resulting compact mass stands up well under ordinary traffic, according to A. L. Hurridge, of the State Highway Department, who developed the novel idea.

Calcium chloride, the chemical used has already proved its usefulness for gravel roads as well. Used in the top dressing of gravel, it renders the road dust proof. No water wagons need sprinkle the highway, for the grains of the chemical seize droplets from the air itself. Six tons of the chemical are used on each mile of road.

Sea Lions Caught with Nets

THESE seals and sea home are said to be expenencing a new sensation, for heretofore, it is declared, this type of animal has never been caught and brought in with note. The picture below shows a small schooner off the west coast of Mexico with what is reputed to be the first haul of this kind, made with netting of tremendous strength.



Thirty colles an hour is classed for coller clustes, culled welling machines, which are driven by rat chat gear wheels that act whenever you take a step-

Five-Mile Road of Gold Ore

WITHIN the concrete paying of a five-mile stretch of Colorado road, just laid, lies \$20,000 worth of gold. High-way engineers found that rock from mine ore dumps was the nearest at hand and most plentiful for mixing the concrete. Despite the quantity of gold it contained, there was not enough to pay for the expensive process for its extraction.

How Colors Aid Eyesight

ARTIFICIAL blue light is best for close work, an investigation reveals. Red is preferred for accing distant objects, ordinary white for all-around work.



The first seals and sea those ever enught, so for so known, in acts, harded in by a schooner off the court of Mexico. Special netting of tremendous strength is said to bine made the feat possible

Junk Makes Queer Golf Links

Have you a dump heap near your home. If so you might lay out a golf course for thereo are the maker of loose bricks, and a variety of crockery went to form hazards for this sporty nine hole course that a large gas company at Hell Gate, N. Y., laid out in its front yard. Upon these baks the player must be careful not to send his ball out of the yard with an unexpected bounce off a piece of steel tubing.

Dam Holds Water with Water

WATER holds back water in an amazing new type of dam, said to be extremely economical to construct, proposed by French engineers. If successful tests of a plaster model are confirmed, a 230 foot dam will be erected near Marege, France.

Instead of one solid masonry wall, the dam will consist of five than concrete ores across the Haute-Dordogne Valley, huch, looking down the valley, is lower than the last, the farthest downstream being only forty-ax feet high. When water is running over their tops they will appear like enseades.

Water fills the space between them, to make up the bulk of the dam. Its weight partly equalizes the pressure on opposite sides of each partition unlike an ordinary dam that has nothing but its own strength to oppose the water's downstream push. Hence, the partitions can be made exceedingly thin with safety, and the total cost of the whole five is said to be far less than that of one massive wall.

Plan to Utilize Moon Power

Pt TTING the moon to work for us is the not far distant prospect held out by the National Geographic Society, by the use of the same force that creates the tides and that makes the great liner Levathan weigh ten or twelve pounds less when the moon is directly over it "In years to come," the society announces. "this moon-force may be harnessed to create power; already plans are under way for the construction of tidal power stations."

Portable Track for Racing Greyhounds



houses for race on portable track Below Ad-Justing ' electric have" on wheel carrying it.

Who Is Father Of Automobile?

"HAT the real inventor of the gasoline automobile was Siegfried Marcus, Austran mechanic, is the

rontention of authorities who plan a statue in his memory at Vienna. As early as 1804, it is mid, the man who won the Golden Cross of Merit for incumdescent lamps and gotary pumps he invented made the world's first motor car. Eleven years later he perfected a model and carried passengers. Not until 1883 did Gottheb Dausler, the German, invent the gasoline engine that assured its success.

In the first engines the gasoline was exploded by heating the outside of a closed tube connected with the cylinder. it was impossible to time the explosions properly, more they lagged behind the poston's motion. Later the electrically ignited motor became forerunner of today's efficient power plants.

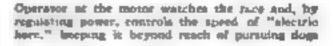
Paving Put to Test

ARD surfaced highways are the I most economical to motorist and town or state alike, according to W. H. Rhodes, New Orleans engineer. "The efficiency expert of a tra-state bus company." he recently told the American Society of Mansepal Improvements. "found that Their heavy busses triuming over gravel cost two cents a mile more in tires than those running over asphalt. A conservative estimate of the mying in wear to the tires of an average cares at least sax tenths of a cent a

On all mads carrying more than 1000 cars a day he declared, the providing of a fund sufface would be a real economy, less costly than repairing the worn-down highway.

Wheels Made of Cotton

WifeN cotton manufacturers sought to find new uses for their fabric, they decided to make wheels of it! Now these odd wheels, used on hand trucks to enable them to roll quartly through factories and offices, have proved successful in recent tests conducted at the War



Department. One of them, revolved against a granding surface, showed no appreciable wear after running an equivalent of more than \$50 noises. Experiments are being made to see if they can be adapted to automobile trucks.

Average Auto Lasts 7 Years

WITH average luck, you might expect your car to last seven years, concludes Prof. C. E. Griffin, of the Univenuty of Michigan, who investigated the history of 100,000 cars. Half of them were out of commission at the end of eeven years, but, after twelve years, more than 3000 were going strong.

Dam Is Engineering Feat

THE great Parcoma Canyon Dam, three bundred and eighty-five feet high, six hundred feet song and a laundred feet thick at the base, considered one of the outstanding engineering feats of our time, will protect Cabfornia a fertile San Fernanda Vadey.



A remarkable view looking down on the \$1,500,000 Pacoima Dum, 385 feet high, which presented tremendone engineering problems and is two years in building

FLEET greyhounds vie for speed records as they pursue the "electric hare" of a new racing outfit, designed by an English inventor and recently miccessful in texts at Beskington. Though in design it resembles the standard race tracks that have popularized greyhound racing in Britain, the latest apparatus is portable and can be set up at any sports meet or fair

At the starting signal the hare is set in motion; a second later the bounds are in full paracut. Though the operator sees that they never catch the hare (for one was torn to pieces when this happened at Southend) they are spurred to great bursts of speed. Their quarry darts along in a lifelike manner at the side of its motive power-a car that is an electric motor on wheels, running along a monature railway of narrow gage.

Electricity to run the outfit is generated by a gas motor and a dynamo.

Twin Panama Canal Foreseen

O WE need another Panama Canal? Although the great waterway is now operating on a sixteen-hour schedule, it may eventually require constant use,

indicates a report of the governor, M. L. Wa ker, to the Secretary of War

During the last fiscal year abipping pressing through the canal set a new high record of 5475 commercial vessels alone, not to mention other craft that brought up the average to nearly seventeen a day. Total cargo carried through the canal was nearly 28,000,000 long tons. Tolks exceeded \$24,000.000. This is five times the traffic of twelve years ago: and if it continues to increase, enlarging of the canal or the digging of a supplemental waterway across Nicaragus may be necessary. Additional locks in the present canal, a suggested remedy, could increase its capacity only about fifty percent, it has been estimated.

Building Wreckers Imitate Explosion



The colleges of hubdings almost 100 years old looked like an explosion and sounded like one, houghward for blocks, when the ancient structures yielded to structures stedges

Mail Trapped by the Desert

TREACHEROUS at all times, the legend-famed link Desert of Monopotasins becomes a sea of mud in rainy sensors, and motor care attempting to cross it are trapped times without number like fires on flypaper. But mail must in spite of all circumstances traverse the forbidding wastes between Bagdad, in Mesopotamia, and Bernit, Mediterranean port of Syria. In the illustration the official mail is being "rescuest" and sped on its way by sturdy natives, who are digging out a marooned transport car

Navy Issues Ocean Air Maps

FOR the sid of trans-Atlantic flyers, the Navy Department's hydrographic office has commenced the publication of "pilot charts of the upper air," showing the most feasible aviation routs for each month. They will be issued throughout the year.

Oil Ditch a Fabric Pattern

F ISHION designers seeling new patterns may well turn to Nature, as the unusual photograph below shows. It is the chance shot of a photographer who saw in the curious mosaic of excles



Photograph y s. f. mar

Fernation of ovals and circles in many indescent colors on the surface of an oil ditch—one of the loveliest pictures in an English exhibition. and ovale of an oil ditch an out-of-theordinary camera subject well worth recording. The striking record he obtained was one of the best exhibits at the London Salon of Photography.

Smaller Dollars Save Millions

TWO thirds the size of the old currency, the small new dollar bill just designed by the U.S. Treasury is expected to save the Government four nullion dollars a year. You will soon be carrying the new-size notes, which were scheduled to be ready by the time this magazine is printed—although it is said that half a billion will be printed before the first is usued.

Since twelve of these can be printed at once on a single sheet, as compared with eight of the old kind, the cost of printing is reduced. Another important feature, studies have shown, in that the smaller bills last much longer. They can be put in the ordinary wallet without folding Ordinary dollar bills have an estimated life of eight months, before, limp and soiled, they return to Washington to be destroyed and made into souveners.

Making All Russia Gas-Proof

Civilian inhabitants of Mescow, Leningrad, and other Russian estimates, men, women and children—are now being provided by the government with "personal gas masks" and instructed in these use, according to reports. "It is our duty to supply them not only to every soldier but also to every working man and inhabitant of the districts behind the war front," Community of War Votumley told the Fourth Soviet Congress, urging that in the unlikely event of war Russia should not be unprepared.

Other suggested plans for protection against possible future air attack by gas include dwellings with gus-tight rooms, supplied by pipe with fresh air from plants with stacks reaching into the air. NO. YOU'RE wrong this is not a picture of an explosion, although it may look like one. In reality the photograph was made when wreckers demolished several ancient buildings in Jersey City New Jersey

The old structures were almost 100 years old and very solidly built. The creak when they finally surrendered to the rasers' sledge hammers was beard several blocks away. The buddings had been condemned, and were destroyed to make way for new constructions.

Heating Plants on Roofs Next?

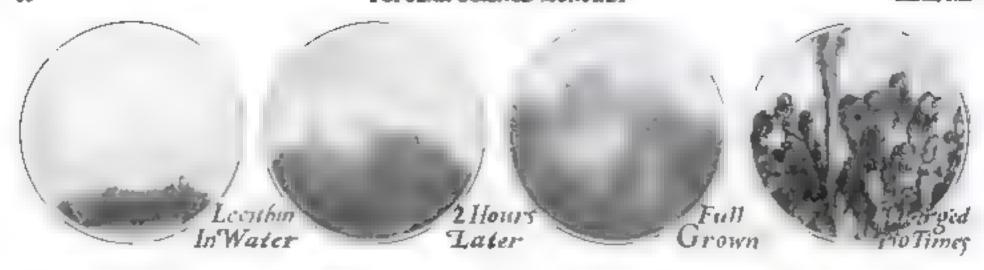
HIFATING plants on the roofs of bruidings may come within a few years, H. Leigh Whitelaw, of New York City, recently told the Pennsylvania Gas Association. Skyseraper owners, he said, would increase their profits by leasing the basements that now hold the heaters. The technical difficulties of adapting heating systems to the topsytury plan could be overcome, he says.

Hens Smash Laying Records

PIRST place in the international egglaying contest just conducted by the Washington State Agricultural College has been won by ten Barred Plymouth Rock hens owned by Prof. H. B. Densmore, of the University of Washington, In one year his pen of hens laid 2507 eggs. This is said to be the first time in positry history that Plymouth Rocks have beaten all other hens, including Legborns, which took second place.

Hotel Radio in Each Room

NOW the guests of a New York City hotel have radio programs on tap through the touch of an electric switch. The entire hotel has just been wired for radio, and two central receiving sets are on the thirty-first floor. Nearly all the 1600 rooms have loudspeakers.



Plants Made by Chemistry

"Seeds" of Metal Salts, Put in Strange,

Poisonous Solutions, Sprout Like Sea Vegetation



Fresh-Water

Chloride



Red Cenweed

TOW artificial plants are grown in test tables through the claimed's The photographs on this page hade by Dr. E. Base show here could

> Cose comment plants reserve parters own programs [15 made of saits of metals are toe seeds which are dropproduction solutions of engage of satartatur pulpite verstarces with its sait with and tel w pressure of potasti a abar ly poison. Le pil s spiricat to of a most of tall starks

When Josephine it was so le plance from the volte of eggsto your and also show I for all of through a not from a to see our but enter a literature to MERCHANIS SINTS

All of the hear all procts are easily ristals a fer low our es let tra de fris los to allower first terms. Let & Spick H. vem spark a life.





Plane Scum



Pot assium Ferrocyanide



Some Typical Sea Plant Growthy

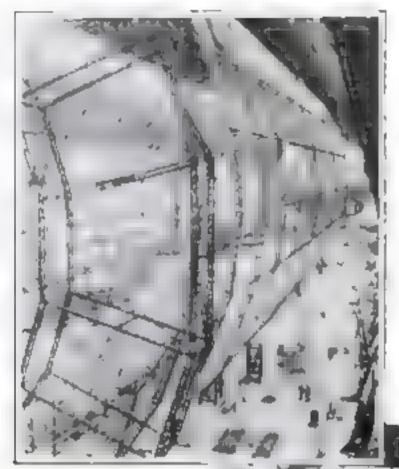






These remarkable photographs show the similarity of the chemically produced artificial plants to the natural ones. The four ar the top of the page show ferithm, from egg yolks, growing. The first three are magnified 50 times and the fourth, 150 times.

Flyers Turn to New Ideas



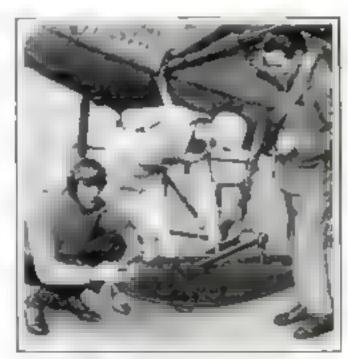
Gigantic durabilities frame of the new Zeppe of LZ of being simplered in Octobry by Hugo E kenter builder of the American diriginity Los Angeles



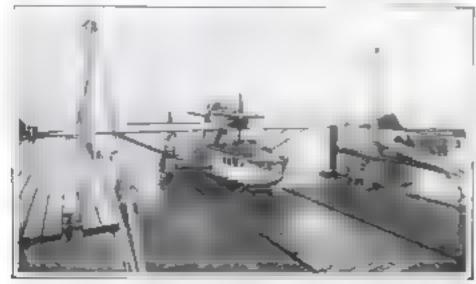
Small day bles now bent acceptate at a case or har age has nowher the for the few districts out to be due to the dat and the figure pull down the shap



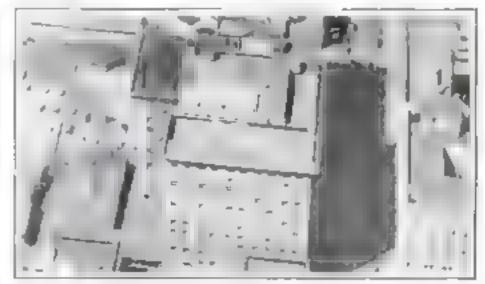
The first hydr gloder equipped with air filled postories are result in a reven test in Her in in drawn y a motor occur as shown in the photograph, and it is to make a cut commutation to that The inventor Mana M late, who is restrict he town of the cold could, declared if more than more aspectations.



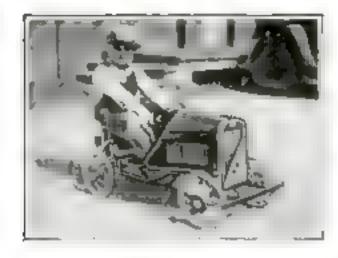
Taking off in tent decrinds in case with this strange cutto in the lamb by great in conting to reports of section to reports of section in Praise. Danger of footing he works as a case relating about the charging of The law is a contact of the shoot M I reviews. The device a revenuety of the shoot M I reviews.



The first floating dock for giant flying boats is above here receiving the Dornier Superwal 'superwhater in Germany. With a supporting capacity of 100 toos, it can also receive simplaces and launch them by cataput.



The largest "nertal algopost" in a city atop a Denver building, is a 110-foot arrow, directing flyers to Lowry Field. It is visible from a height of 5000 feet. The plan is recommended to all owners of large buildings



Toy Car Claims Speed Mark

FASTEST of toy automobiles, says the maker, is a new lightweight ear for the children. Among its novel features are a safety system of double braces and a patented bicyclehke sprocket that enables the youthful driver to go forward, reverse, brake and coast at will. Steered by the conventional wheel, it is propelled by a chain drive similar to that of a standard racing automobile. The car is of all-steel construction, hence durability is claimed as one of its virtues.

Baboons as Servants Advised

If YOU need a faithful, efficient house servant, not subject to human faitings, tey a bahoon. That is the starting advice of Prof. P. A. Landemann, of Oxford University, England. In twenty years, he declares, there need be no servant problem. This is the time it would take, he says, to breed apes intelligent enough for sample household duties—dusting and sweeping, for instance.

Steam Well Power Unlimited

GREAT, undeveloped power resources —the smoklering first within the earth-have just come to for attention with a recent survey of the California natural steam wells. Two experts of the Carnegie Institution, Dr. E. T. Allen and Dr. Arthur L. Day, have reported the results of the first thorough investigation of its kind in America. Despite eight borings in the local area where natural steam is abundant, a little valley hear San Francisco, the tapping has eaused no apparent reduction, they find, in the available pressure of from sixty to 278 pounds. There seems no reason why further enterprises should not be conducted on a larger scale, as has been done at Larderello, Italy, to furnish commercial power

The Italian natural steam, they point out, contains corresive substances and must undergo a costly purification before it can be used in machines, but the California steam is pure enough to use directly as it comes from the ground.

Scaplane Can Go 4000 Miles

EVERYTHING new in aeronantical science is and to be incorporated in the Navy's latest sesplane—a grant with a cruising radius of 3000 to 4000 miles that could conquer the Pacific! The first of these "PN-11" planes, secretly built at Philadelphia, has just been completed, and twenty-five more are to follow

Secretary of the Navy Wilbur, denying

reports that the plane will be used in a Pacific or globe-gredling flight, states that it will be placed in regular service. It is designed to carry about 1900 gallons of gasoline, more than Commander Byrd's huge plane bore on its flight across the Atlantic to France.

New Way to Tell Time in Bed

TO TELL the time, without turning in bed, an English inventor had devised an apparatus that projects to the ceiling a magnified, illuminated image of his watch-face! He slips his watch into the device before retiring, a touch of an electric switch conveniently located on his bed at any time during the night and the hour is indicated above him.

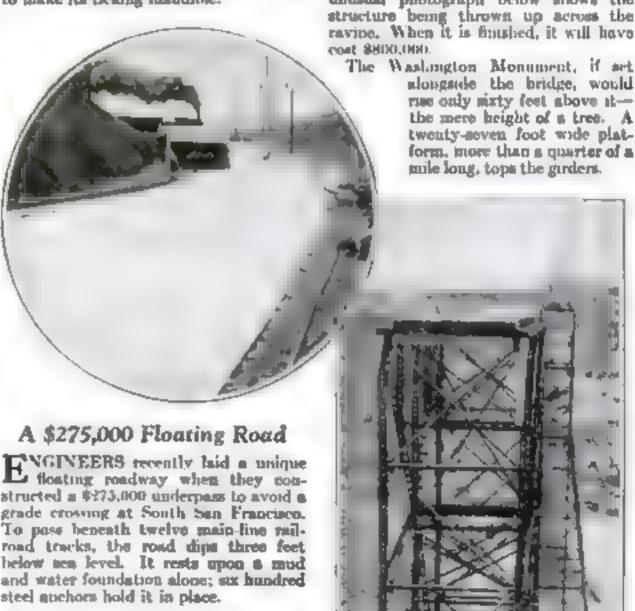
Within the box shaped apparatus are an electric bulb, a mirror, and a lens to accomplish his end. It is the reflected, magnified image of the watch or clock face that the electer sees. The annoyance of a noisy timepiece is obviated, as it can be placed far enough from the bed to make its ticking inaudible.

Planes Use Costliest Wood At \$600 for Thousand Feet

PROBABLY the highest-priced lumber that comes from a log, lumbermen say, is the hand-picked Sitks aprace used in the building of airplanes. Not every log will supply the quality demanded a clear straight grained spruce of the lughest standard. Only a half dozen rules in the Pacific Northwest can supply the rare wood, and it takes from three to six weeks to assemble a carload. The average simplane requires for its manufacture nearly a thousand feet of the spruce, at \$600 a thousand, for its wing beams, strats and other parts.

Bridge Nearly 500 Feet High

IN A short time, what it and to be the highest bridge in America—if not in the world—will be completed. It spans an Idaho river north of Twin Falls, at the tremendous height of 490 feet. This unusual photograph below shows the structure being thrown up across the ravine. When it is finished, it will have cost \$8000.000.



New Chemical "Ice" for Rink

NO MATTER bow hot it is, you can akate and coast as in undwinter on a new kind of "ice" devised by German chemists, now installed in a Breslan exhibition hall and skating rink. Although, it is said, you can slip and fall on it as effectively as on the natural substance, the new compound does not melt even at a heat of 208 degrees!

Resembling the frost that collects on ammonia refrigeration pipes, the artificial product is poured on wood and hardens quickly. Its manufacture is by a secret process, although it is known to be purely chemical: no machinery whatever is needed in order to make it.

An immunal close-up photograph of what is called America's highest bridge, in Idaho. The 550-foot Washington Maximument would top it by only 60 feet

Steel House Erected in Little Over Three Hours

HAT is said to be a speed record or home construction was achieved recently at horest Huls. Now where are intects and engineers saw work men erect the steel framework of a two story dwelling in three hours and twenty minutes. It was a demonstration of a new system of bouse building by the use of standardized steel members similar to those used in constructing akyserspers.

When Robert Tappan, architect and engineer who designed the steel house mounted its skeletonike beginnings and gave the starting signal, the fabrical ed.

frame lugan roung.

By going a step farther and turning out factory-made porches, vestibility changes and bay windows, it is possible to construct seventy percent of a bosine's

parts in an industrial plant. Tappen says. He plans to erect houses of this type throughout the country. Through the economy of standardination, he declares, they will cost less than wonden houses do today

Steel framework makes the house practically indestructible, it is said, and the dwelling can-

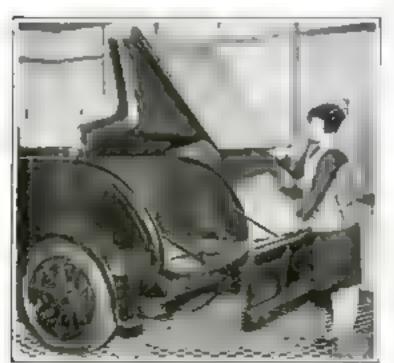
not warp or shrink

Foolproof Elevator

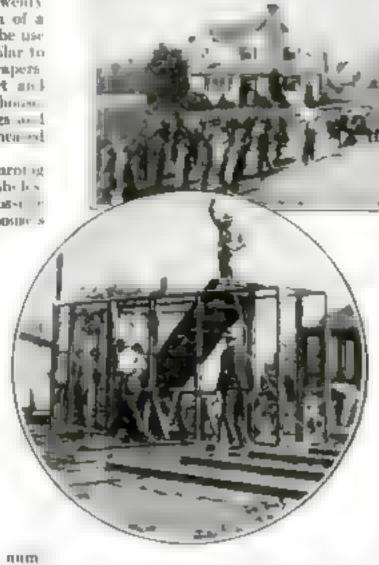
YOU can't be carried past your floor in the latest type of automatic elevator, recently introduced in New York and other American cities. On the

ground floor the operator presses a numbered button for every stop desired. Then he starts the elevator; without further control, it shoots upward and stops at the first floor called for. The doors fly open nutomatically; a touch of a lever closes them and the elevator continues uptil it stops at the next level desired.

So perfect is the mechanical control that the elevator always stops with its bottom edge flish with the floor. On its down trip, the elevator again stops automatically at every floor where a waiting passenger has pressed the "down" button on the wall of the corndor



The new English folding top that collapses into the rear of the motor car when not in use and in bad weather converts the machine into a series. When out of service it cannot be seen



Open Car and Sedan in One

WHEN the weather is on its bad behavior, the open car loses much of its attractiveness. It is a quick change to a closed one with a remarkable new convertible type of automobile recently exhibited at Westminster, England. From the rear compartment, as seen below, unfolds a substantial top that is quickly set in place and made weather-tight. In fair weather the covering is completely hidden and the car's lines are unmarred by the presence of a

folded top. Even with the coverfolded away there is said to be ample space in the rear compartment for luggage, tools, and spare automobile parts.

Any Questions?

THIS magazine is olways. glad to answer inquires of renders concerning all subjects withou its scope and to formship names and addresses, whenever possible of the nuckers of acticles described in its pages. Replica are made as promptly as possible in view of the time required for research, and every effort is made for absolute accuracy. Inquiries should be accompanied by stamped self-addressed envelopes and directed to Information Department, Portlan. SCIENCE MONTHLY, 250 Fourth. Avenue, New York City.

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Star a Pulsating Gas Bubble

GLOWING graunta bubble of gas A that slands and swels as the ne from one r s ha est description of Mira a remarkable star that grass the celes of equator. Recent observations win the asl of a light-recording i is rement devised by Pro. A. A. Mirchell attached to the great 100 met belese se at Mount Wilson Observatory, prove that an the star becomes periodically bright and disc. a phenomenon of which astronomers have been aware for centuries, it actually waxes and waters to sate. Astronomers believe the amazing power that blows the gases composing the star outward and sucks them in at intervals of eleven months comes by extraction of energy from the atoms of matter

Betelgeuse dims and brightens for a different reason, says Dz. Joel Stebbins, I inversity of Wisconsin astronomer. A red star, such as this one, he proposes, probably has "star spots" that, rotating, periodically obscure part of its face.

Magnifying Your Strength

BY THE lightest touch of your hands, through a marvelous new mechanical device, you have power enough to steer a ship or aim a huge gun. These are the latest uses seen for the "torque simplifier," developed under direction of H. W. Nieman at the Bethlebern Steel Works and described in the January Populate Survey Montion.

When you turn the "control shaft," the "work shaft." turns in the same direction and its power is ten to fifty thousand times greater than yours!

Bright Children Not "Queer"

UNUSUALLY bright children are neither queer nor likely to become so later. That is the openion of a number of authorities. Clever children, they agree, generally come of distinguished parents, have unusually good health, are fond of play, are popular with other children and show no peculiarities.

Odd Utilities and

Ferris Wheel Preserves
Phone Girls Bundles
Pocket Tray for
Other Strange

Phonograph Relieves Phone Girls

"The number is changed; pieces consult new directory," a mechanical voice now tells phone users in Peris. When a changed number is called the operators savy labor and avoid delaying other calls by pingging in on the ever-runging device

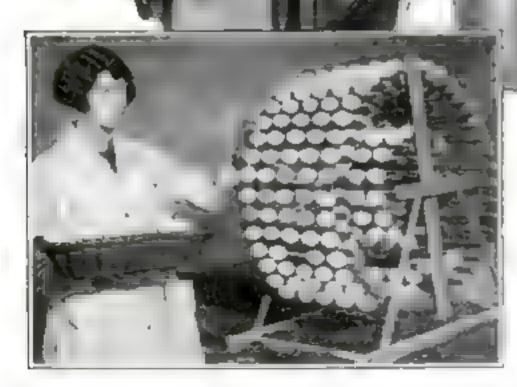
A Vest Pocket Ash Tray

Cigarette test, sub preciver and extinguisher are combined to an unusual case that saves embarramment when you are deep in a divan and your makes threaten your hostess' rug. The air tight cover extinguishes the stub



What a Harmonica Grows Up to Be

A tube, one would call this instrument at first glader, but, believe it or not it is a harmonies, Rusea from the lowly level of the mouth organ, this carries the came of symphonic chromatic base harmonics here. Solouts in orchestrae play on it

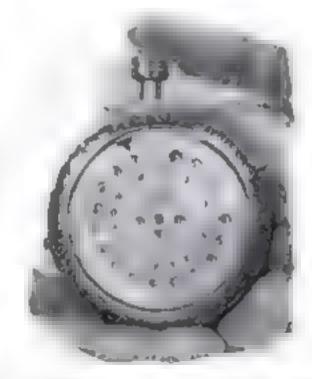


Eggs Kept Fresh by Daily Ride on Tiny Ferris Wheel

Aftering of their position returns the natural ageing of eggs, according to Australian Government food experts, who extered this device in a recent food and cookery show in London. The apparatus can carry a total of 400 eggs

Ending Nusance of Wet Umbrelia

Demage to floors and to clothing is avoided by the united acider allustrated above for churches and halls, invented by Ambrone O'Rourice, of New York City. The holder is attacked to the end of a pew or row of scatt, as shows at the extreme left a tube fitted into the bottom drawn the water through a bole in the floor into a pail or other receptacle that is cunveniently bung, Losing umbrelles in cost room is also ended by the novel device



Novel Golf Scorer in Watch Case

Disputes are avoided by this device whose stem you press at every golf stroke. It totals each hole ground the dial, adding them all up in the center

Useful Oddities

Eggs—Phonograph Assists Wrapped by Machine—

Cigarette Ashes— New Inventions



Garage Door Dogs

An ingeniously emple but practive device to hold garage doors open to a pointed sprint fastened on a truy metal rack. When dropped it stacks into the ground, when not in use it evan an a holder. A touck of the foot operates it



These who don't reliab gloss will welcome the pseudust thirmble size device norm at the right, for moretening en vilopes. At pressure of the fargets in spongy rubber end draws water from the small reservoir in the tube and then returns what is not needed for the envelope. The handle can be unscrewed very nearly when retiling brooms necessary.



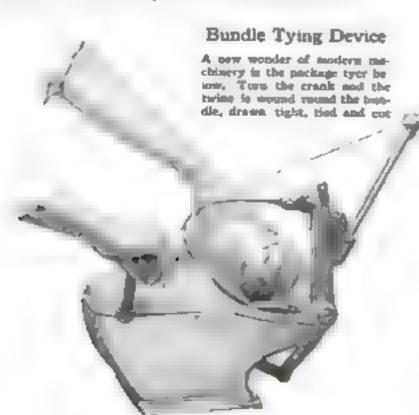
A Slot Machine Soda Fountain

A nickel in the slot gets you your favorite sode in an establishment recently opened in New York's Great White Way district. The coin makes the machine set an individual cup under the apigot and start the flow. Open the door—there's your drink all missels.



New Light's Colored Rays Fight White Fog

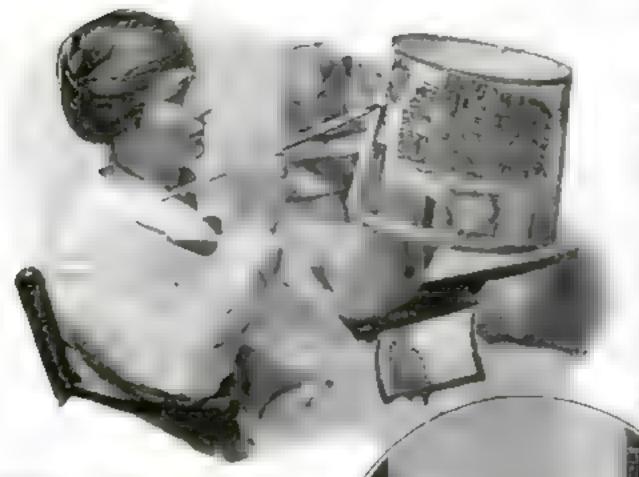
W. E. C. Stone of Los Angeles, has developed for use of aviators a samp whose surrectored beams contrast thurply with menacing vapor making landing safer. A blending of selected furtals is the reflector breaks maturas miored electric light into its constituent colors, sending them brundesst over a wide area.





Novel One Wheel Luggage Carrier for Motor Cars

Less combersome than two wheel trailers, and holding four times the baggage that ordinarily can be carried this device, recently introduced in England, may be folded up when not in one. It is devised to fit any standard type of our



Old Maps Make Lamp Shades

OUAINT old maps, some of them used by generals in planning campaigns are now turned to a far different use by won en who have them cleaned, variabled and but into lamp shades. Many mak a rac we pictures when framed

In the photograph a final cost of various et being applied. The sourced sections represent part of or a cost town the building at the left is the charets.

Fingerprints Identify Races

BY FING-RPRINTS the world's trees can be roughly classified into West European, Itman, Indian, Japanese and Mane area, result a vest grove showed. Prosts of persons of the same race were similar. This may help even tually to perfect the specific classification and subdivision of races.

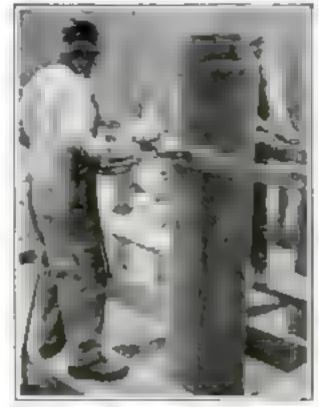
Unique playing cards made of riles, which remind one of Mah Jong and dominors, add novelty to a bridge party and permut play on the porch or in the parden us a fair but windy day. They last forever

Novel Saw Cuts 24 Piles in 50 Minutes

TWO minutes and "she's through"—
with a new electrically drives chain
saw that has been applied to pile cutting. Such was the time "clocked" for
this heavy twenty-inch piling, and but
fifty minutes was required to cut a row
of twenty four. Weighing only seventy
pounds, this device, which promises
great saving in dock work, is easily
portable. A two-horsepower motor drives
the saw.

Sky Plays with Sound Waves

FAR up in the air amazing things happen to sound waves. Dr. F. J. W. Whippie, of the Kew Observatory, England, found not long ago that sometimes he could hear a cannon sixty miles away eleven minutes after it had been fired, normally the sound would take less than half this time to cover the distance. At some nearer points the explosions were mandiale. Whippie suggests that cound waves are sometimes reflected back to earth from a warm atmospheric layer twenty-five miles or more above.



The new two-horsepower chain new that curs off the top of a pile 20 inches in diameter in two minutes. It is portable, weighing only 20 pounds

Playing Cards in Tile Form Defy Wind and Hard Usage

A NEW deck of eards in tile form, which borrows the traits of Mah lands at the hostess give her bridge party on the parch without fear of a sudden land disturbing the eards. Their solid construction prevents the wear that brings form corners and cracked backs the countries of ards.

tive box which, as seen below, also provides undividual racks for holding the hands." The tiles are not dealt, but each player picks his own, as in dominous.

Clock Times Life of Truck

HOW long can a truck run before it wears out? So owners may determed and thus know the actual cost of tracks a their business, a new clock its astronomy has been invented. Attached

to any moving part, it starts to register when motion commences and stops when the machine is alle. Its dial tells just how many bours up to ten thousand, that a truck, or for that matter any machine, has been run, regardless of the speed at which it operates.

The period of active use often sets the real ble of a machine, instead of the days or months of off-and-on use. A huge cannon, for instance, must be related after an active ble of about three seconds, the time required to fire 150 to 200 shouls.

Know Your Car

A VARIETY of accidents can happen to your automobile that will cause trouble and expense, but there are forms of carelessness for which you may have to pay with your life.

Driving with weak or defective brakes is one of them. Failure to inspect the running gear and steering mechanism at regular intervals is another. You can't plead ignorance so far as poor brakes are concerned, because you can't drive any distance without knowing just how your brakes are working. So if you get into trouble with brakes, blame yourself,

That doesn't apply to trouble in the running gear and steering mechanism. Everything may work fine until some day, when you are speeding along a mee road, a loose bolt drope out and you are dumped into a ditch or plastered against a telegraph pole. Go over every bolt and nut in the running gear and steering mechanism regularly?

New Paint Striping Device Lets Anyone Decorate Auto

A NEW tool makes long practice unnerdessary for automobile paint striping jobs. With one of these instruments, idustrated below, any striped design work may be duplicated by an inexperenced painter

The compassible device has two interchangeable parrels for fine and medium lines attached to one arm and fed by a rubber lacquer-container. The other arm is used for a guide along a molding or rule and stripes are spaced as desired by adjusting the thumb acrew. Curved, straight, or design lines may be made.

Longer life of the stripes is claimed by the maker because a slightly thicker coat of lacquer is said to be applied than in the case of work done by hand.

Toad Challenges Camera's Speed

OFFICIALS of the Landon Zoo recently obtained the first movies of a Spanish toad swallowing but meal of a worm. A camera taking 1500 pictures a second was required! One taking 500 a second had completely missed the eating act

When the authorites carried off their first flow and developed it, they

found they and good pretures of the toad, but between two of them the worm amply disappeared and how he went remained as much a mystery as ever When they succeeded with the faster connects the film showed the toad's tongue

How Much Do You Know of the World You Live In?

THESE questions are selected from hundreds sent in by readers. Test your knowledge with them. Correct an event are on page 166.

- 1. What is the northernmost town in the world?
- What country is especially famous for its butter?
- Where is fresh water found 200 miles at sea?
- 4. Where do men have their wives whipped by law?
- 5. Where does the abelone live?
- 6. What Alaska city is as warm as Philadelphia?
- 7. Where do goldfish come from?
- 8. What is a "dry lake"?
- Where is there a lake of crystal sods?
- 10. What are the Antipodes?
- 11. Where are prayers burned instead of being said?
- 12. What became of the Temple of Solomon?

hatting the worm much as a hatter strikes a ball, and whisking it out of night into his mouth. It was all over in less than a axticth of a second.



The machine for painting goripes on switte their of the form of a campans. One arm serves as guide the other current inverthangeable than and madium barrala from which incquer is fed in even ince-

Tree Stump an Incinerator

THE question of what to do with old tree stumps has been almost as buffling as the time bonored "What shall we do with our old range blades?"

H. W. Ayers, of Burbank, Calif., made an uninerator out of one in his back yard which was so successful that neighbors were not slow in copying it. Ayers says be got the idea from a dream. The picture below shows him giving his novet and useful contrivance the finishing touches.



The refuse incinerator made from an old free stump on his back yard, to which H. W. Ayers, of Burbank, Cauf., is here seen applying the familing touches.

A Mechanical Professor

A D now we have the mechanical tutor a portable professor, to be exact! It is a device that will teach you foreign languages, card games, and the like. If you would learn bridge, for example, all you do is place the arm with the squared indicator over the line of pictures illustrating that game and turn on the power. A phonograph attachment explains the points of the game as each picture comes to view. A synchronizing device makes this possible

A. L. Runyon, a mechanical engineer of Los Angeles, invented the machine.

Cheap Cornstalk Walls Now

WALIBOARD made from cornstalks, a long-standing laboratory achievement is now about to become a commercial process thanks to air months' research by specialists of the 1.5. Bureau of Standards. At present the longe cornerop is called the outstanding example of faces waste in the United States—less than twenty percent is used as food.

Last year Congress appropriated \$30,000 for the Bureau of Standards to use in seeking to chimnate waste, as described in the May, 1927, Portian Science Monthly, by putting constalks, peanut shells, collog burns and cotton need buils to use. Now, after experiments, a plant for the manufacture of wallboard from cornstalks has been set up in cooperation with the Iowa State College, according to Dr. W. E. Emley, director of the research.

The expects have simplified the problem of extracting from peanut shells nonedable sugars valuable to the soft drink and tanning industries. These, it is expected, will soon be available to industry. Furfural widely used to make synthetic resins, is promised by cottonseed hulls. The tons of cotton burrs left unused by cotton gins still await a profitable use; though Dr. Emley says that all these wastes furnish a reliabose, from which artificial silk can be made.

Electric Signs Flash Paris News Bulletins



Light bulbs turned on and off by a spendied band passing behind them dash the letters of the stends, giving Parisian crowds the latest news. The bulletin seen refers to the American Congress

The machine that cuts stencil ferters on the step of heavy paper, spearing out the news base on the be flashed from tops of perspaper offices in Physics

N INGENIOUS news-thishing as a t in this been used of late to Paris newspapers to inform the bouleyard crowds of the day's latest developments. The device resembles the running adverlising phrases and time agoals flashed in some of our larger American cities, but offers up-to-the-minute news which the operator receives by telephone and spells out on a lettered machine. That in turn steneds a heavy paper band that is run over the lines of a frame carrying a bank of electric sights. Each built in the frame has a wire which causes it to light when touched by the stenciled letters, and thus spell out the sentences to those below

Sugar Produced by Chemistry

FOR years intoratory experimenters have sought in view to depure the secret processes by which living plants form starch and sugar from southelt, enston dioxide gas absorbed from the atmosphere, and water taken in through their roots. At last, by an ingenious method, Prof. E. C. C. Baly, of Liverpool I niversity, has succeeded

To water and earbon dioxide in a glass take he added colored catalysts in the form of salts carbonate of makel and cobalt. When the mixture was exposed to visible light from an electric lamp it produced substances that passed all the chemical tests for sugar.

Professor Baly found also that growing plants may need the polarized light from the moon to convert into sugar the starch stored up in the leaves by direct light from the sug.

Heart No Pump, Says Doctor

THE accepted idea of the heart as an automatic pump sending blood to all parts of the body may have to be revised.

A famous German heart specialist Dr. Mendelsohn, mays the heart is simply a governor to control the orderly flow of the blood, thus current stack being due to the constant intake and outgo of liquid caused by chemical action in the body cells.

Dr. Mendelsohn says the heart, a small nuscle the size of a man's fist, "could not possibly be capable of driving the tenamous mass of the blood through the entire body." He cites invalids with bearts so flabby as to release scarcely any energy, yet they lived for years with sufficient blood circulation.

The heart, he says, takes constant care that the blood flow he orderly.

Engineers'World News Service

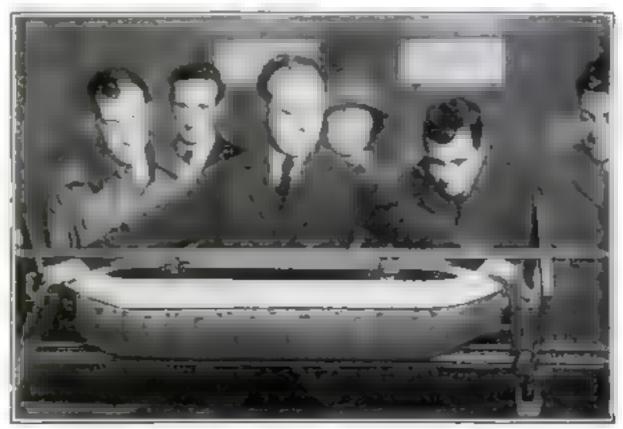
WHAT engineers are doing the world over a made available as a moment by a remarkable new service of the American Society of Mechanical Fugineers. Labranes and other subscribers receive each week a batch of index earls to be filed in a special cabinet, bearing titles and abstracts of articles on engineering problems that have just appeared in American and foreign technical papers.

For those who have restricted interests, early hearing only information on their subjects are supplied. More than a thousand publications of thirty-seven countries are digested for the subscribers.

Monorail Cars under River

MONORAIL cars will send at sixty miles as hour beneath the River Tyne on a new type of underground railway seen below, designed by E. W. kearney, British engineer, if his plan, already possed by the Muistry of Transport, is approved by Parasinest First of its kind, the tube is to connect North and South Sawids. Along the middle of its floor will run the single rail that supports the weight of the novel schway cars a guide rail above keeps them from topping and completes the electric encountry which they receive power

By chanusing awaying and joling, the track design permits high speed the inventor says. Stations will be elevated above the tube level, giving cam a "rimning start" downgrate and automatically slowing them at the other end. This is said to result in a great saving in power, and reduction of joils and wear



E. W. Everony, British engineer, exhibits model of the monorall cars with another sail above to steady them and supply electrical power, which he expects to run in a tennel beneath the River Type

Cement Mine a 40-Acre Mushroom Farm



Parming by torchlight under the ground is the business of Housed Stati, who is open here with a guardine flare, tending some of his forty acres of muthrouse beds. This unique large scale guidening operation goes on its an abandoned coment mine, where the temperature is ideal for mushrouse.

O'NE of the strangest farms in the world of the great subterranean acreage of Howard Bell, of Crittenden, N. Y., on which he raises huge crops of mushrooms. Becking means to cultivate the delicacy, which thrives without daylight, on a wholesale scale, Bell conceived the idea of using an abandoned cement mine. The results were even better than he anticipated.

Throughout the entire underground agricultural plant a temperature of from forty-seven to fifty-one degrees is maintained the year round, thus being ideal

for the product.

Little light is used in the operation of the unique farm of forty acres. Bell tends his plants with the aid of gasoline or other artificial illumination. None of

the mushrooms in his heds ever sees our.

Thousands of persons grow mushrooms in cellars for their own use or for market. Bell has many thousands of cellars in one.

"Coldest Spot" Is 452 Below

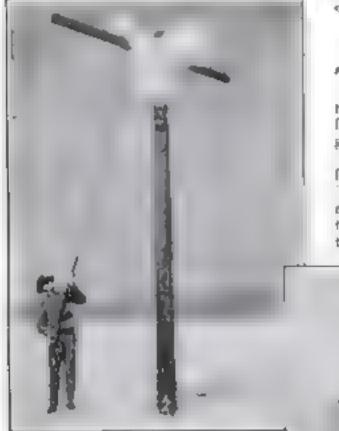
THE coldest spot on earth is a new laboratory in Berlin, to study strange changes that take place in substances exposed to temperatures as low as 45% degrees below zero—within about eight points of alimitute zero! This is done by injuefying belowing as under high pressure, then allowing it to expand.

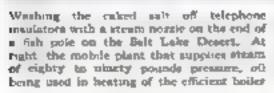
At such a temperature some metals, such as silver and copper for example, lose their resutance to electricity, becoming super-conductors. A thread of frozen mercury at is said, can carry enough character for a veral lamined lamps

Phone Insulators' Bath Day

THE EPHONE lose machators in the Poult Lake Desert, I all have a regular weak day to remove sait blown from near-by bods, which cakes on the glass and causes leakage of electricity.

Steam is speaked over the insulators from a nozzle or the end of a fish pole. Though an ageing action on the glass results. B. F. Howard, engager of the telephone is uspany, says the economy of the method be has developed justifies it.







Optical Device Gages Heat

EVEN the blistering heat of molten metal pouring from a furnish can be measured conveniently and accurately by a new instrument resembling a small telescope. When it is pointed at the glowing atream, the brightness of the reflection seen through the eveniese at taken to indicate the temperature. Through an adjustable dual this glow is compared with that of a small electric flamings bulb within the device, and the exact number of degrees directly indicated when the two are matched through a red aighting glass.

This simplified optical pyrometer, as the device is caded, will measure accurately the temperature of a glowing body only a quarter inch in size ten feet away! Unlike types that record electrically the heat of a fire, an nighted through a furnace door, this matriment can test the temperature of pouring metal and of small bodies not inclosed.

icires not introduci.

Why Boys Eat So Much

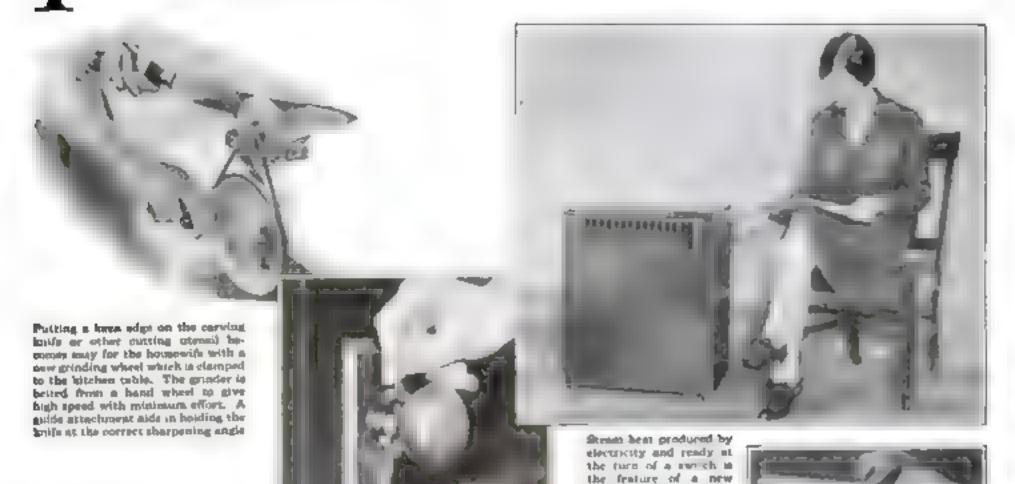
I YOUR son puts away a bigger meal than you yourself can eat, don't be surprised, advises the Bureau of Home Economics of the U. S. Department of Agriculture. He is merely behaving like any normal, active boy of nine to eighteen. At certain ages boys and girls may need one to one and a half times as much protein and mineral matter as adults, according to a new dietary scale worked out by the Bureau that gives the needs of each member of the family.

Do Radio Waves Never Die?

THAT the voices of famous present day men, transformed into radio waves, are now wandering around the earth and may be picked up a century hence is the starting contention of engineers of the Marcoul Company, London. Such waves, they say, never die out completely; with sensitive enough receivers they might be heard in 2028? Already they have heard programs that have circled the world three times.

Commenting on the idea, Dr. Lee de Forest, inventor of the vacuum tube, said, "Theoretically the waves exist forever, as do those of the ocean. The splash made by Noah's ark is still in existence. Radio waves are too weak to be recorded by existing receivers even a few minutes after their emission."

Inventors' Ideas Add to



portable bearing cabinet. The little radiator need only be plugged into a

wall or hosp societ. It

m so light that it can be

moved on casters from

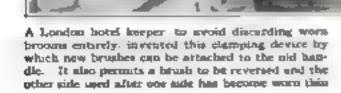
ruges to ruges as weeked.

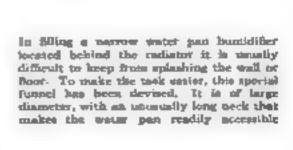
Mary's a new, one hand flour eiter that leaves your other hand free for maxing dough or besting better. When you aqueen the binged grap, on agreater whirle back and forth over the affear's wire bottom and speeds the flour on its way. The operation is rapid and convenient

A new idea in mechanical hungler election in a large going holeed to the disor knob to that when the knob to that when the going (maintly arouses the entire household. No hall teries for electrical connections are required.

No danger of accidentally semoving a bottle of poison, in the dark, in mistake for another, from a new folding medicine carriest pictured above. It has a separate compartment at the top for the poisonous substances

Johnnie won't know where the cookies are kept for a while, at least—if they're placed in the secret top compartment of the bread and pastry cabinet at the left. Both of these are portable onbinets, folding to fit into a small space

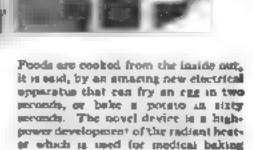




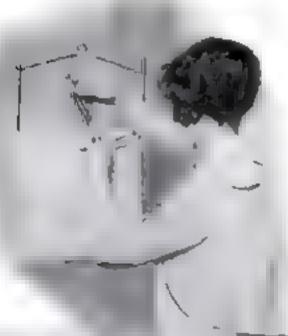
Home Comfort



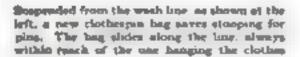
Provided with two drawers and a spacious top surface, a unique new inclosure for the ordinarily unsightly radiator serves as a useful desk or library table. Heat is radiated through a grating below the drawers, but the construction is such that magazines, books, or writing material may be placed inside without damage from the heat from the radiator



The bottle stopper attachment below not only keeps the fire in half filled bottles of ginger ale or charged water, but converts them into syphons. A slight pressure on the knob at the top discharges the contents of the bottle

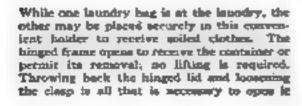


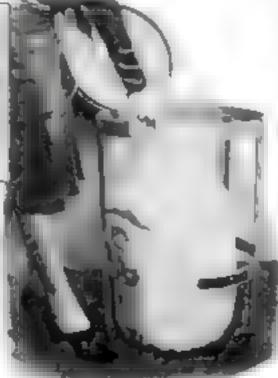
When the funneled fid of this new cooker in filled with cold weller, it prevents uscape of liquids from food being cooked, by condensing the preum so it arrows. The top part is bright off to put its food.

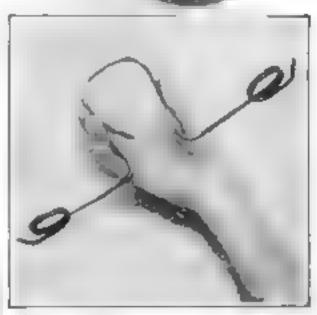




The inventor of these sciences claims they need never be charpened. An occasional right hand turn on a small adjustment occaw regulates the tension in such a way that the blades sharpes themselves. No screw driver is needed to do it







It's easy to take the use out of old upholistered chairs and make them so good as new, it is easd, by the use of a new type of spring designed to give them new life. A set of the springs can be assuched beneath the old sent up a few minutes

Locating Your Radio Trouble

Here an Expert Tells How to Build and Use Inexpensive And Effective Apparatus to Test Your Set When It Fails

By ALEXANDER SENAUKE, E.E.

ROUBLE shooting, as practiced by the average radio fan, consuts mostly of shooting in the

Suppose that some evening the set goes dead. You test the batteries and find them all right. Then you look over the wires to the batteries and find nothing wrong. After that you rame the bd of the receiver and note that all the tubes are lighted. So far you have pursued the search for trouble in the approved fasheon. but from there on you spend a lot of time shooting in the dark, hoping that you will be lucky enough to stamble on the trouble in time to ward off a visit from the radio service.

You take the tohes out of the accepts and polars the ends of the prough hou make sure that the spring contacts in the sockets are in

good shape and taen you begin an nomless prodding around mode the receiver with a piece of wood or the end of your fourtum pen. Sometimen you find a loose wire that is the cause of all the trouble but I you have no sach lack, then what do you do? The chances are you give it up as a bad job and prome for the repairman to come up and fix the set

BUT you don't have to give up so quickly. It's quite easy to learn low to service your own set when some-Bring goes wrong and medenlinds even a reputation among your friends as an expect radio trouble shooter.

In previous articles in Populars Science Monthly we have outlined the simpler thangs you should do when the set goes dead, such as testing the batteries, looking for poor contacts and making the other investigations that are possible without the aid of special apparatus. Now we want to show you how to go several steps fart or either with laboratory appara-Las autable for the purpose or by means of simpler and less expensive homeigade apparatus.

The first principle of radio trouble shooting is to take nothing for granted Don't consider that a single thing about the radio set is as it should be until you have definitely proved by adequate test that it really is all right. Don't assume, for instance, that the storage A bottery is charged just because the tubes light. They often glow at a temperature just below the heat that makes them effective and then you will be fooled. Nothing but a hydrometer

In Radio Trouble Shooting—

"Take nothing for granted, prove it by testing," says Mr. Senauke, who is the assistant director of the Popular Science Institute of Standards.

"Test batteries first, then tubes, then hunt broken connections or poor contacts.

"Avoid aunless poking around; follow each circuit from one end to the other.

"One broken wire will render a set completely inoperative. One dead tube will kill reception.

"Never prod ground inside the set with anything made of metal

text of each individual cell should satisfy you that nothing is wrong with the buttery. And even then a poor connection in the A battery wires may be preventing the current from getting to the tube liminents.

Samplarly, don't assume that the antenia is in good condition and the ground connection firmly made, merely because they were right last week or last mouth. Personally inspect them to make

Propresent of what is known as a laboralory type test net, such as is above in ose in Fig. 2, will put you in a position to

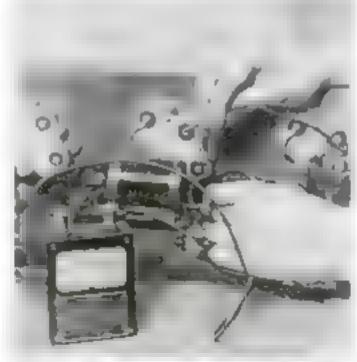


Fig. 1. This circuit tester, with a small flashlight bettery under will metantly reveal an open circuit and will show on its dial the amount of repittates

find out at once the most vital information about any radio set, and that is the condition of the tubes. It also will enable you to chantate at once many possible sources of

The vacuum tabes, as you know, are the supremely vita, parts of your set. All of the other parts are there merely to permit the tubes to function as they should. And the filement is the heart of the vacuum tobe. Waen beated to the proper temperature it sends out the stream of electrons that makes the tube perform its task of amplifying the radio aignals received by way of your autenua They allow it to rectify and thus detect the signals so that they are nut into a form a stable to be heard by the human ear and without a constant flow of electrons from their filaments, vacuum tubes used as audio amplifiers could not amplify by

many bundreds of times the extremely weak signals passed on from the detector

OF COLESE, you can't make yourself small and craw, ponde the vacuum tube in order to count the follows of electrons as they fly off from the heated filament through the grid and to the plate of the tube. But you can accomplub the same result by measuring how much current rider across between the plate and the flament on this stream of electrons. This is excled the plate current and it is taken from the B-nationes or

the B-enminator, depending on how the set is equipped.

The test set measures this plate current. It also enables you to tell, merely by turning a knob or pressing a but ton, the voltage of the plate current as it actually is applied to the plate of

Obviously, if the meter shows that ninety volts is being applied to the plate of the tube, you can be sure that the wiring of the B-circuit for that particular tube is right clear back to the B-battery or B-chaminator.

THE test set also shows the actual filament voltage applied to the filament of the tube being tested. If you find, for unitance, that the filament voltage is five, you know with absolute certainty that the storage battery is right and that the A wiring is right, and you can cross these off your list of possible sources of the trouble

another turn of the knob or the pressure of a different button and the meter shows the C-voltage being applied to the tube and tells you at once that either the C-circuit is in order or that something is definitely wrong.

In other words, when you put the test plug in the socket in place of the tube and place the tube in the socket provided in the test set, you can instantly tell whether the tube is good; whether the A, B and C voltages are correct for the tube and if these circuits are working as they should. Marely by turning a knob or pressing different buttons you eliminate at once the possibility of trouble

in the majority of places where troubles can occur.

By placing the test plug in each socket in the set you accomplish in a minute as much testing as could be done by the tedious testing of the individual circuits one at a time.

HOWEVER, laboratory type test sets, which cost about \$75.00, are somewhat beyond the means of the average radio fan, although one should be a part of the equipment of any professional radio service man worthy of the name.

But even if you can't afford such an elaborate piece of apparatus, you can build yourself a test set for about seven or eight dollars that will be amply accurate for your purposes, even if it does not equal the precision of the

special test sets.

The circuit of such a test set is shown in Fig. 3. The meter is a Weston No. Soft reading from 0 to 7 volts D.C. The fixed resistance R is 15,000 ohms. In addition to these parts you will need a double pole, double throw switch, an ordinary bell push-button, a vacuum tibe socket, two binding posts and a special dummy plug that you can make out of a base from a discarded vacuum tibe.

Mount the apparatus on a board or fit it to the top of a cigar hox with the wiring inside. You can make it just as claborate or as simple as you want. To construct the dummy tube plug, break out all the glass and cement in the base and solder the G and F wires to the prongs that make contact with the G and P springs in a vacuum tube socket-Fit small pin jacks or spring wire clips to the two filament prongs, which are the two thick prongs on the base of any modern X-type tube. The object of this arrangement of the filament leads from the test set is to allow you to reverse them if you run into a set in which the plus wiring as to the minus terminal of a socket.

TO USE the test set you have built, plug the dummy plug into the socket in place of the tube you wish to test, placing the tube itself in the socket you have in the test set.

Throw the switch to the left and the nieter will read the filament or A-voltage actually being applied to the tube terminals. This should be very close to five volta for a 201A type tube. If it is over that figure, the rheostat is turned too far. If you can't get it up to five volts by turning the rheostat, then either the storage battery is dangerously low or there is a poor connection somewhere in the A-circuit or the A-battery wiring.

Now throw the switch to the right and the meter will tell you the amount of plate current flowing through the tube. One volt on the meter-will be equivalent to 2.3 milliamperes of plate current. The plate current depends, of course, on the plate or B-voltage and on the C-voltage. If the plate voltage is mostly and the C bias is four and one half, the plate cur-



Fig. 2. Tenting a radio receiver by ments of a laboratory type test set. This device gives facts about goodston of tubes for guidance in correcting trouble

rent should be two and one half millisuperes. If it is below one and a half milliamperes the tube is poor and should be rejuverated or replaced by a new one. If the plate voltage is innety without any C has the plate current for a good tube should be about any influmperes. If below four, discard or rejuverate.

TO determine the plate voltage, leave the switch thrown to the right and take the tube out of the nocket in the test set and then press the button. The meter will now read the voltage of the plate or B-circuit as applied to it by the B-batteries or B-circuit as applied to it by the B-batteries or B-circuit as applied to it by the B-batteries or B-circuit as applied to it by the B-batteries or B-circuit as applied to it by the B-batteries or B-circuit as applied to it by the B-batteries or B-circuit as applied to it by the B-batteries or that if the hand stands at slightly less than three on the scale the B-voltage is ninety, or if it points to ax it is 180.

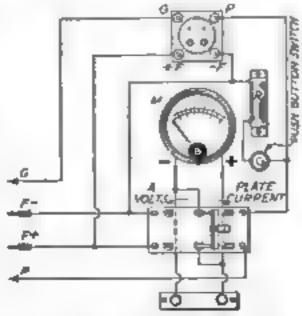


Fig. 3. The circuit of a home-built test set not no accurate as the inhoratory model of a service man, but good enough for most face

The test set cannot be arranged to show the C-voltage without rather complicated awitching, but you can test the C-battery directly by connecting it to the two building posts with the switch in the open position.

These two binding posts also herve mother useful purpose. By connecting them in series with a four-and-one-

half volt. C-bettery and any portion of the circuit in the radio set not already proved up by the tests already outhied, you can definitely determine that the current is complete. If the meter does not read, the suspected circuit is open at some point. If the meter reads, you can be absolutely certain that there is a continuous metallic circuit. If the circuit being tested is just a few feet of wire with some connections and perhaps one of the tuning roils, the meter should read the full four and one half volts developed by the C-battery. If the circuit includes a fixed resistance of any value beyond a few ohns, or perhaps the primary or secondary winding of the audio transformers, the reading will be considerably less than four and one half volts.

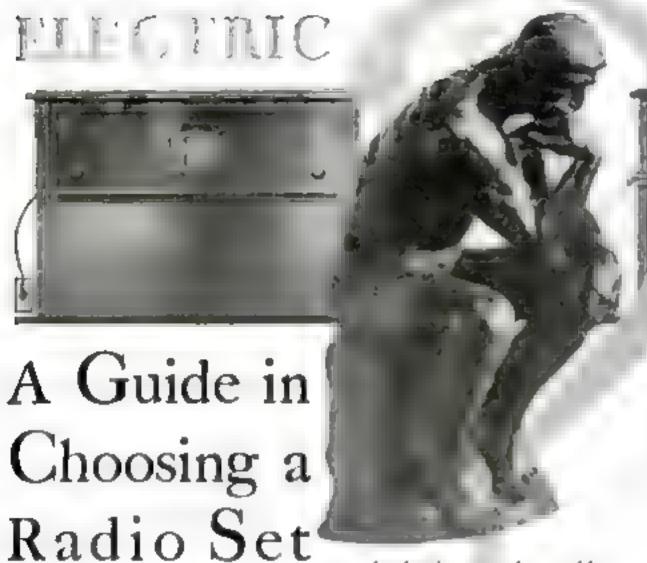
A METER designed for testing the continuity of any circuit and showing its approximate resistance is shown in Fig. 1. Such an instrument is a valuable addition to the equipment of any man engaged in radio testing as a profession, but for home purposes the simple arrangement here-

tofore mentioned wisl auflice.

A small flashight cell is fitted inside the meter, so that no additional batteries need be used. The dist is culibrated in degrees, and there is a table printed on the lower part of the dial so that you can determine the approximate resistance of the circuit as well as whether the circuit es continuous or not. This feature enables you to elseck the value of the vamous fixed resistances in the receiver or the power unst. In using a special meter of this type, or so testing circuits to see that they are not broken by means of the home built test set diagrammed in Fig. 8 with the aid of a four-end-one-half-volt C-battery, remember radio circuits often provide several paths between two given points. hor metance, you might touch one wire of your test circuit to the finament terminal of a socket and the other to the wire run-ning to the terminal. The meter would show a continuous circuit even if the wire did not make contact with the socket terminal. I he corrent from the four-andone-hast-volt battery would flow between the two pourts by way of the tube filament in the socket being tested or through the filaments of other tubes connected to parallel with it

WHILE most of the troubles that beset a radio receiver show up at once in poor tone quality or some other obvious form, there is one that affects neither tone quality or volume. If the Chattery supplying a power tube gives out so that the voltage drops below where it ought to be, the tube will still work well, afthough its life will be materially shortened. Never operate a power tube, particularly the 171 type, at lower than recommended C-voltage.

BATTERY



An Aencle The Popular of Stan Approved by Science Institute dards

HEV is a radio received an electric set and when is it it? Which is better a battery set or an electric set? Which is better better with the socket privar " "electrical" full electrical defect from the socket and all the other new radio terms actually mean?

If you spenk of a relective a stome? le you need one operated by electricity and perforce one operated by electricity from storage anticres formelectro pado reserver would meet note operated by electricity but as there is no such thing as a ratio receiver operated by northing else been true not been given a new and quite grinterity meaning as applied to radio.

Broadly speaking, an electric radio rerever is one that operates without but teres. That a about as near as you can rome to defining the term electror as it applies at present to ranio receivers. What it may ment as months or a year from now nobody can tell, store it had no such meaning in the first place and is now being widely, loosely, and often erroneously used.

The terms "electrified," "socket power" "direct from the light worket" are piecely various peoples yless of correct terms for outfits that fit is somewhere between the hattery operated set and the so-called electric set

TO CHOOSE intelligently among a battery operated set, an electric set and the combinations in between, you must know the essential outerences among them

Of course if you have no electric light current in your home you are out of it so far as an electric set is concerned. Your problem is to choose from among the Lattery operated sets the one that meets you are in a district where the current supply service is creater and the voltage fluctuates to a serious degree. In certain outlying districts the lights get quite dim during the early evening bours when everyone is using current and they may be extra length late in the evening after most people may gone to bed. An electric set can be used on such a line, but the results are hable to be just as erratic as the corrent supply.

But if you are located where the light current service is reasonably atends you have a wide choice of equipment all designed to get the same results that is adequate reception of broadcasting. And if you choose good apparatus you will get the desired results equally well, whether the set is battery operated, partly electrified or full electric. There aboutd be not difference in actual radio reception between a battery set and an electric set. They can be equally sensitive and equally selective. There is no choice for tone quality. The only difference is in the amount of attention and care required.

M VKE sure that you have alternating current of the proper voltage and frequency before you invest any money. If your current is not 110-volt sixty-evels or if it is direct current you will need special equipment.

When you are buying your radio equipment forget all the high sounding terms and find out just what you are buying and how it operates, and read the instructions that accompany the equipment.

Note particularly what, if anything, you have to do at penodic intervals. The Types of Receivers

What You Can Get

From the Several

sdeal of course is a set that requeres absolutely no attention beyond the occasional replacing of a tube that has gone dead.

By JOHN CARR

Don't let anyone fool you rate believing that there is a radio receiver which operates directly on the row 110-volt alternating current just as at comes from your light nocket. Such a receiver has never been produced and probably never will be. Direct current to the B at I C err conta of a radio rese ser, a air absolute necessity, and consequently any radio recover that operates without batteries has a B-champator tucked away there it somewhere. This Bigh monitor is to ref intents and partiones, exactly like the Behonnator year buy to use in place of dry ceals on a battery operated re-4393 07

THE A circuit is another story. In the electric set there are three distinct methods used to accomplish the results attained by the storage battery in the ordinary battery operated receiver.

The amplest and most widely used method is to employ special so-called A C tubes that can be operated directly our aw alternating current after it has been stepped down from 110 volts to a sartable low voltage. This usually is accomplished by an extra winding on the transformer in the built as B-cl. minator.

There is no nivstery about these A C tubes. The 226 and similar type tubes are exactly like the regular 201A tubes except that they have a very thick filament that has a low resistance and consequently will operate on a very low voltage, about one and one half volts. The filament heats relatively slowly and doesn't fluctuate to temperature with the rapid changes in the flow of alternating current. These tubes could just (Continued on page 1.2)

He Rebuilt His House and Saved \$6000

How a 60-Year-Old Residence Became A Modern Home— Hints You Can Use

B

JOHN R. McMAHON

AM going to buy that old house on the hill and fix it up in a way you never heard of," and my friend Joe Penka about a year ago,

"Put it on wheels and take it to Florida in winter?" I hazarded.

"No, although I do have a piece of land down there. My scheme is to make it a combination of a one-family and a two-family house, so that it can be used either way on short notice."

That sounds fairly original, but what

is the object?

"I want to live in the house myself," explained Joe, "been ase it is a nice location several hundred feet back from the road fine view and everything but it is too large for my family of four. I like company and wouldn't mind sharing the house with another family. That means adding a few rooms and putting in duplex conveniences, But suppose we change our minds about sharing, or my family increases, or somebody offers a good price for a one-family residence? With my scheme it wouldn't take more than a week to change the layout either way."

"There are difficulties," I observed. "For example, both sets of folks will want the front porch. Perhaps a movable par-

fition is the answer

"NO, I'LL divide that porch with an imaginary line." said Penka. "It isn't practical to divide a kitchen with an imaginary line, but you can a front porch if the people concerned are at all congenial and friendly."

"You may be right, and if it doesn't work it will be the fault of the other family," was my comment. "But how about the architectural lines of the house?"

"They're terrible now, aren't they? Look queer on every ade except the front and that isn't much to boast of. There's a twostory box gummed onto the



North and front sate of the Penks house before (small upper photograph) and after it was made over. Half of the specious inclosed parch is used by the teams from ly occupying the limit floor of the house, the other half to used by the Penks, who make their house above

back, and brude it a little storm porch like a chicken coop—and another shed on the apposite side. The open front porch with its long spindly columns takes a lot of space and gives no service except in summer. But some of the linear are good and I rather like the pointed arch windows that you don't often see today. The rounded triangle windows for the affic are interesting and the wide overhang of the roof with the prominent corniers appeals to me. Now my idea to to replace the rear additions with a onestory structure that will match or balance with a sumlar glassed in front porch, Then the house will barmonize with itself and will look well from any side.

Y Ot need a good architect, and he may charge you a thousand dollars. 'I expect to be my own architect and Joe. I have a college diploma as a land-

scape architect—and the principles of landscaping and house designing are a good deal the same—proportion, harmony and contrast. And of course I learned a good while ago how to make scale drawings, which is no great trick, although many corpenter-bankters shy away from them."

JOSEPH PENKA is one of those men who belief he proverb that a jack-of-all-trades is master of none. There is at least half a secretist in his makeup. After working in a greenhouse, he launched into market gardening on borrowed capital, originated a discuss-proof lettuce, and within a few years made a modest fortune. He sold out to invest in a laundry and a public garage. Before tacking the job described in this arricle he had built a house and remodeled two.

To make radical changes in an old

building is a proposition always followed by a question mark. All kinds of unforceers difficulties may develop. Who knows whether the inside material is sound? In this case a careful survey convinced the owner that the job was worth while. The house was alsout sixty years old, which meant, in this locality at least, good materials and stanch construction. Due attention had been paid to unkeep. Oak and white pine were the choice elements of the original dwelling, nor were these tunbers skimped in all dimensions according to modern style.

The cutrance hall showed the proudest schievement of the old builder, a flight of stairs with a solid walnut balustrade that did not terminate at the second floor.



An integimery like divides the two-family inclosed purch of the house that Joseph Proba made over. Me and Mrs. Peaks are on opposite sides of the line, which runs through the doorways the families share





Rant under of the 60-year-old house before it was made over Note the cold, uninviting front porch and the unsightly loan-to "gummod on to the rear

East side of the made over house showing, at the left the kitchen of the first floor tenants and at the right, their half of front parch, d visted from the owner a by an imaginary line. Note improved appearance or company with picture at right



West side of the old house, whose good lines were deprived of their affects by the uneightly front porch and rear additions before they were replaced with improvements that contributed to the symmetry of the whole structure



made it worth white to chuck the old freet perch and the additions at the rear, and hald the toclosed porch, left, and the intrhene, one of them seen at the right

but curved generfully around to protect the opering above. Such a baboteat is a rarrity and rould not be deplicated Inday for less than a theresand dollars.

Place were four course drawnships and the same mnoter up. The mt ration planenfect for a division along the late of the main stairway, giving the owner ad the up ser rosons of which one would become a lying room and another a both with a part of the new test thou rear od lition as a rathernative son parlor-katchen urd half of the new front porch. The other fam ly quartered entirely on the first floor, was to have living room, dimog room, two bedrooms, kitchen and bath. All would share the front entrance, the owner having an extra side entrance to the front porch.

PIEE seliense required a glassed in front porch fourteen by thirty six feet and a rear months of the same size for two kitchens, one regular and the other convertable to a sun parlor. Plumbing was simplified by two sacks on either side of a partition. The bathrooms were not located with the same economy,

although there is a common waste pipe in the cellar.

The layout of space indicates no dining room for the owner ! However, there is room for a dining alcove in the wide light main hall under the stairs, not to mention the sun parlorkitchen.

When a hudder asked \$12,000 for the job. Joe decided to be his own contractor. It took him a year of as we or less steady work to make all the changes, and the cost was about \$6000. figuring his own labor at \$3,500

A contractor figures ten percent over estimated actual cost on new work, but he donties the ante on an alteration job so as to allow for all an spected troubles and costs," said Joe. In this case he would have had no temples and would have eleared a couple of thousand dollars."

ALL but the inside plastering and elec-trical wiring were done by the versatile owner. The outlay for these items with outside help was around 6700 aparce.

To extend the old cellar beneath the new additions did not seem necessary, but concrete foundations to a depth below frost were made along the new lines. A celiarless construction with double floors and building paper between, is satistactory in mild climates at least, but good ventilation is imperative, for woodwork in a confined damp space is subject to rapid decay. In this case vents were placed in the outer foundation walls and

Your Own Bailding Problems

WHAT has been your experience and the experience of your friends in building and rebuilding houses? What problems confronted you and bow did you meet them? What problems do you face now? Write the answers to these questions to the Home Building Department and Mr. McMahon will make your experiences the subjects of his new series of articles about real houses of real people, of which this is the first. Letters should be addressed to Rome Building Department, POPI LAR SCIENCE MONTHLY, 250 Fourth Avenue, New York

windows were inserted in the cellar walls so that in summer air might sweep under the entire house.

The framing of the new sections floor jousts, rafters and study was done in fir, which consures favorably with oak for the purpose. Stinls and joists were spaced according to the usual modern standard of sixteen a ches between centers, patters, twenty melies. Sheatning boards of yedow pine and then halding paper were applied.

To match the old style white pine clapboards for the outside wall, sprace was used. If aproce is not the equal of white pure in exposed positions, it still ranks high in resistance to decay and I kept pointed will endure as long as anything

else that you might use.

AOST of the original interior trun-downstairs was left in place, while fir and whete pine were selected for new trim

I govered all the floors, new and ckl, upstairs and down with oak said Penka. "The old boards had shrunk, leaving cracks where dust and dirt settled. No

air came through the cracks from below because the boards were tongue-and-groove, yet cold could get through. double floor with paper between layers is warmer than a single fluor. It is stiffer, dues not sag or creak, Also, white pune is too soft to stand much direct wear.

"I used white oak, sawed flat granti, (Continued on page 148,



It costs more to replace a poor Bearing than to buy the best that **5 KF** ever produced

Let's get right down to this matter of bearings and consider them, not on the basis of their purchase price, but on the basis of cost price. For cost price is the thing you pay.

It does not profit a man much to buy a bearing because the price is low and then actually pay more for lubrication, adjustments, repairs, than if he had bought the best bearing in the world

It does not profit a man much to buy a low-priced bearing if a valuable machine goes out of service just because the bearing could not stand up.

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For good on a bearing, like the sterling mark on alver, represents a definite standard of quality and you can depend on one just as surely as you can depend upon the other.

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1966

When You Buy a Car_

Beware of the Big Trade-in Allowance and the Service Graft, Says Gus



MAS a masser of fact of a classic ray. Replication on the section to the desired agreement of the community of the community

"I could answer a lot resser if you dask
what isn't the matter with it," Joe grumbled as he bung his hat and overcoat on
the door of the tiny office in the Model
Garage, "I'm afraid the time has come
when I've got to dig into the old bank roll
and get me a new car."

"It's about time," Gus chuckled. "I've been wondering how much longer you were going to keep that old wreck."

"I could fix it up easy enough if I wanted to," retorted Joe.

"Sure you could " that agreed. "No car over gets so old that it can't be put us good running order—if you're willing to spend money; but there comes a time when its parts began to lay down one after another and it doesn't pay to try to fix it. You've had your money's worth out of your car; now you'd better turn it over to the junk man. What kind of a car are you thinking of buying?"

"Whoever will give me the biggest allowance on the old but gets my order,"

replied Joe. "You my all cars are about alike, so I'm going to shop around and see how much money I can mave."

"And probably get stung doing it." predicted time. "I declare, Joe, you certainly don't show much sense sometimes. When did I ever say that all cars are exactly slike? What I said was that any modern car will give good service—and that's all I meant. Some cars are much better buys from a price point of view than others. And you'll generally get the biggest allowance offers from the dealers who sell the worst bargains.

"THE dealer who has the hardest time acting his cars usually is the most liberal with trade-in allowances. Besides some manufacturers put a fictitious list price on their models just so the dealers can make higger allowances. The thing to do is pick your car first and then find the dealer who'll give you the best allowance. Hello! What's that?—"

Gus broke off suddenly as the front door of the garage closed with a violent smash

"I tell you you're cockao!" growled an angry voice from the shop. "That car's a legion if there ever was one!" By MARTIN BUNN

"G'wan! You don't know what you re talking about!" came another equally beated voice.

"More grief!" whispered Gus, after perping out the office window. "It is my causant from up Winchester way. Another morning shot to pieces! Hello, folks'" be called out as he snapped the last buckle on his overalls and stepped out into view. "What's all the row about?"

"Well, you see it's this way, Gus." began one of the two as he fished a bundle of automobile catalogues and circulars out of his pocket. "Ben and I have decided to buy new cars this spring and I've been trying to get Ben to take my advice but he see darn pig-headed he won't do it."

"Pig-headed, am I!" exclaimed Ben.
"Maybe I am—because I know I'm right—but your dome sure is made of solid concrete—"

"THAT'S no way to start a visit," interrupted Gus, "but I suppose the argument is what brought you here, so let a go in the other and get it settled.

"I gether," he continued when they had settled themselves around the table with the bternture spread out before them, "that you've each chosen a different make. What care are you thinking of buying?"

"I could preffy near have guessed right on both of you." Gus smiled after they had beliggeredly announced their choices, "You still working in the tool room at the Mandey works, Hank?" he inquired, turning to the man who was wearing the flannel shirt.

"You bet," Hank replied. "I'm fore-

"And you, Ben, I suppose, are still the leading legal light of Winchester?"

"I m still practining law," Ben corrected him.

HAVE it your own way" granted that. "Anyway, each of you is an expert in one particular line. But you've driven all the way down here just to get my opinion on a line that neither of you is expert in-mutomobiles.

The car you've picked, Hank, is fast. It's got lots of pep on the hills. It doesn't ride any too easy unless you fit it with shock absorbers and keep them adjusted just right. The motor will give good service if it gets just the proper care, and there are a number of other things about the car that require touching up every now and then if you want good service. But, balancing the advantages against the disadvantages. I'd say it was a mighty fine car

Hank genned trumphantly. "Told you so!" he suckered.

"On the other (Continued on page 138)



A Radiotron for every purpose

RADIOTRON UX-291-A

PADIOTRON LIV-100

RADIOTRON UX-190

RADIOTRON WO-18

MADIOTRON WX-12

RADIOTRON LT -200-A

PADIOTRON LX 128

MADIOTRON UX-222

RADIOTRON UK-ITP-A

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RADIOTRON LX 216

RADIOTRON UX-240

NADIOTHON UX-213

RADIOTRON UX-258

RADIOTRON UY-827

RADIOTRON UX-200

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Marinet Tury

The standard by which other vocume cubes our rated



Every Radiotron is tested and inspected in 41 different ways before it is approved in the laboratories and factories of RCA, General Electric and Westinghouse.

The Radiotron is the joint product of RCA, Westinghouse and General Electric, developed and perfected in the same great laboratories which give you the MAZDA lamp. They are the creation of the skilled radio engineers who made modern broadcasting possible. Equip your set with genuine RCA Radiotrons. Never use new rubes with old ones that have been in use a year or more. See that your set is completely equipped with RCA Radiotrons once a year at least.

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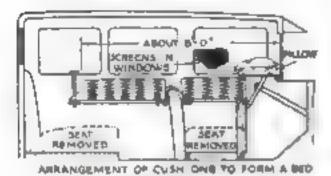
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246 VULCAN ST. BUFFALO, N.Y.



Kinks That Will Help Your Car

Auto Convertible into Bedroom—Garage Doors That Close Themselves—Handy Quick Acting Jack—Other Good Ideas



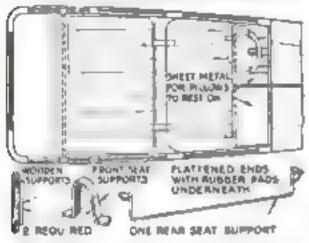


Fig. 1. Seet cushions can be made to serve as a mattree in camping. Screen two windows

A Bed in a Motor Car

I he regular front and rear seat embious of your closed car as a fied while auto comping. As you will note from Fig. 1, you will need to construct one long brackof to support the rear and of the rear seat common. The code of this bracket rest on

the rear window ails to fit a rubber pad on each end of the brackets. The two brackets that fit over the back of the front seat are heavy strap iron. If the front seats are devided you wilt need for r

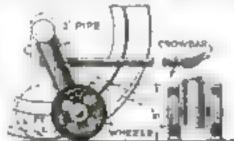


Fig. 3. Sample park made of an old trowbut, a bolt and pullty wheels.

brackets, two for each front seat. Wooden a poerts hold the front edge of the front stat cushion and a sheet metal support for the pillows completes the bed. A long roll shaped cushion can be fitted into the space between the front and rear cushions if desired.

A Quick-Acting Jack

Willias the regular style of jack that you usually earry in the tool kit is of course, adequate for emergency the changes on the road, you will find that a simple quick-acting jack such as is shown in Fig. 2 will save a lot of back-breaking work in the home garage. The materials you need to construct this jack are an old crowbar, a piece of heavy three-inch pipe, a long half-toch bolt and two five-inch iron wheels. Ordinary crown pulleys will

do nicely. The upper end of the pape is rounded to fit the axle. Be sure to drill the hole for the crowbar at the proper angle. Then when the crowbar strikes the ground the wheels will have rolled just past center under the axle.

Back Through Garage Doors!

OPENING the garage doors, driving out and then having to get out of the car to shut the doors after you is a nusance when you are in a horry. By constructing garage doors after the fashion shown in Fig. 5 you will be able to back right through the doors, and they will close after you, eliminating the necessity for getting out to close them by hand. As you will note from the drawing, a rope or cable is arranged over pulleys so that awaying the lower half of the door down automatically raises the upper half. You will laive to work out the locations of the polarys to soit your own garage. He save that the lower half of the door is had. strong enough to stand the weight of the cur and ose counterweights to exact the closing with rubber bimpers to take up

Tool Boxes in the Floor

IN LONG trips it is difficult to find room for extra tools. Fig. 4 shows how to solve the problem. If you will take up the floorboards in front of the rear sent you

will find that there is plenty of room for at least one deep tool box and one shallow one. The latter is necessary to clear the exhaust pape. Make the boxes of galvanized iron riveted together at the seams. Remember that the body with the tool boxes draps down much nearer the axle when the car goes over a

bump, and allow plenty of clearance. The diastration also shows a next accongenicut

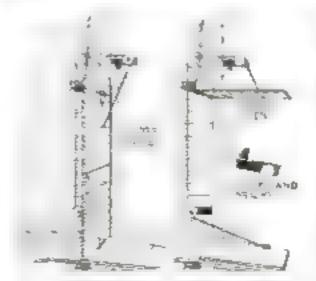


Fig. 3. Countraction of gauge doors that will close themselves after you have backed out

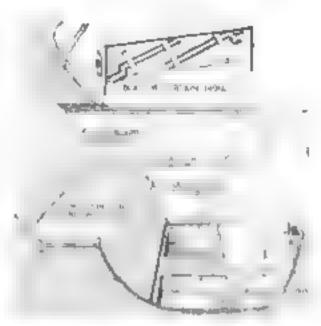


Fig. 4 Extra compartments for tools and odds and toda can be fitted under year floorboards

for packing the cortain irons. The shallow ten box for small tools to alip under the driver's sent, also shown in the drawing as particularly good for closed cars of the coach type, where the front scats tip forward.

Swinging Stop Light

MOST care sold today are regularly fitted will stup I guts but lare is a way to make vales more effective than the standard. Look over Fig. 5. In place

of the regular stop light fit a board, and to the top of il attach an ordiharv vacuum type windshield wiper Replace the wiper with a lightweight tost-light. The rubbet base should he rue to a valve on the dash board and the other side of the valve piped to the intake manthat of the motor Lac hulb in the swinging stop light



Fig. 5. A awinging stop light commands unmediate attention

should be wired to the regular stop light switch, operated by the foot brake

Ten Dollars for an Idea!

P. B. ASHBY, of Strathcons, Alberta, Canada, with the \$10 prize this month with his garage door suggestion (Fig. 3). POPULAR SCIENCE MONTHLY awards \$10 monthly, in addition to regular space rates, for the best suggestion for motorists. Other contributions published are paid for at usual rates.

1768

IMPORTANT

160th Anniversary

Congratulations!

From all over America, telegrame of appreciation are pouring in every day. Here are a few of them:

From Charles Evans Hughes, Former Secretary of States

I heartity congrutatant you an the Am-provency of the founding of the Ency-elopsedia Bettennics, on event of high significance and prest public benefit in the systematic diffusion of knowledge.

From Andrew W. Mellon, Secretary of the Treesury, Washington, D. C.z.

Please accept my congratulations on the one hundred and citited anniversary of the founding of the Encyclopsedia Britanners. This publication has exerted a most profound and for reaching under ence on education throughout the world and has performed a service of man-timable value its making readily available. such an accurate and comprehensive body ef knowjedge.

From Sir Robert Borden, Ex-Premier of Canada:

Upon the one hundred and sixtich m-niversity of the founding of the Bary-clopsedia Britannica, prey accept my songratulations and my best makes for a fitting and inspiring resolvation. It is indeed an event of marked againstance having regard in the service of this great publication in the cause of education and curtare.

From Dr. S. Parkes Cadman, Brooklyn, N. T.

The Encyclopeedia Scienzifes is by comon concent the first work of its aunit fold and permanent ways to the culture of all English-speaking number, so well es tu other civilized lands.

I congrutulate you upon its perenoial youth and vigor it reaches its one himdred and sixtleth antitiversary with a water range of information than every before during its long and liketrious COPPORT.

From Mary Roberts Rinebart, Muther and Playeright:

My gratitude and admiration to the Soevelopsedia Britannica on its one hundred and sixtleth anniversary. The amount of authoritative knowledge dimensioned by It is that foog period canada possibly be estimated. Its wide extermation makes for evillanting. Its contribution securits divilention is the largest made by any ringle agency. I am never without it.

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My hearty felicitations upon the 160th Appiversary of the founding of the En-cyclopaedia Britannica. The great work has placed the specificantal world under a debr of deep gretitude. The Encyclo-postic Britantica's second of advecting knowledge forms a complete libeary within reelf.

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YOU can now realize your lifelong wish to own the Ency-V clopaedia Britannica—the genuine Britannica, recognized the world over as the greatest library of knowledge in the world! For this great work is now available at a NEW LOW PRICE, and upon Easy Terms of Payment that anyone can afford. To those who have put off ordering a set, this 160th ANNIVERSARY SALE offers an opportunity to save many dollars on the very latest Britannica.

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The Britannica's 160th Anniversary is an event of tremendous importance from the standpoint of culture and education, And, in order to make this great event mean something tangible to the general public, the publishers of the Britannics have arranged for a special printing of the latest 13th Edition, to be sold at a price so low that no one need now be without this indispensable work.

Far in advance of this great sale, orders were placed for all the necessary materials. More than a million pounds of Britannica Opacity paper -inks and cloth and leather in correspondingly large quantities—have been purchased from the manufacturers at prices which only the Britannica could secure, owing to the immense volume of its business country is the world is also represented in which is world-wide.

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ways, stands head and shoulders above every other work of reference ever published. Its Edition, stands in a class of its own, un-

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Booklet

ANNOUNCEMENT

1928

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equaled and unrivated. From time to time, other publishers have tried to make cheap imitations of it, in a doesn different innguages, but these have died out after one or two editions because none of them could stand comparison with the Betanoica.

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Nothing cise can take the place of the Britannica in this respect. Its value cannot be measured in dellars and cents. It is the one work you and your family cannot afford to do without.

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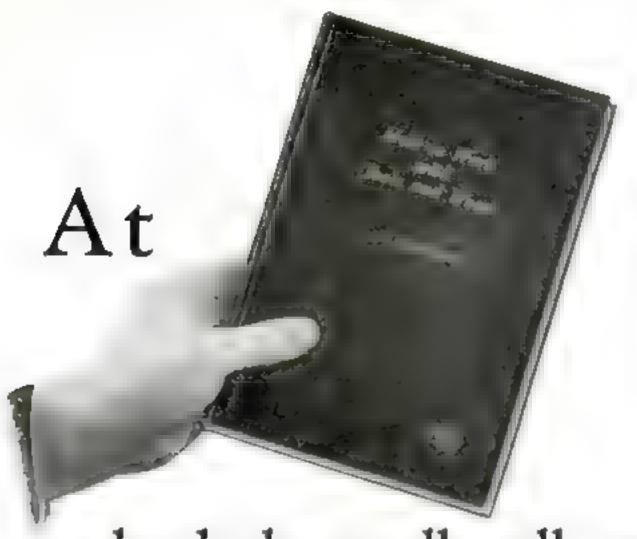
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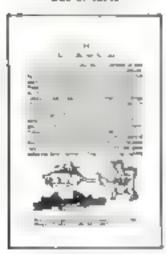


last!

a book that really tells you-How to work with Tools and Wood



How to get the most



How to place with the grain

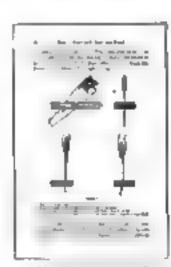
Here is a book which every tool-user should own. It takes all the mystery out of using tools, selecting materials, and planning and finishing work. It enables you to repair furniture, put up shelves and do many other odd jobs about your home. It opens the way to make many useful objects-from a book rack to a kitchen cabinet.

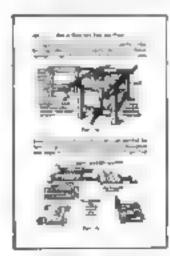
This is a complete guide. Every question you have ever wanted to ask about tools and woodworking is answered in this book. Over 150 illustrations and diagrams make it valuable to the advanced worker as well as the beginner. A-complete cross-index makes it an instant reference book on the use and care of tools, and the selection of lumber, paint, varnish, etc.

Contains 185 pages. Durably bound in blue cloth. This book, if sold in the regular way would cost you at least \$2.00. But the price is only \$1.00-at your hardware dealer's. If he does not carry it in stock, send us one dollar in money order, check, or stamps for your

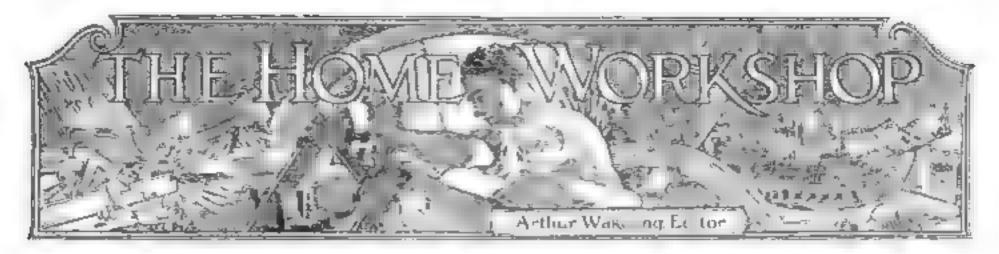








Row to glue parts together



The Simplest Flying Model

Anyone Can Build Successfully This Little Single-Stick Monoplane

By J. D. BUNCH and A. F KOCH

The success of commercial aviation tomorrow lies with the joungaters of today. From among them will come our successful designers, manufacturers, promoters and flyers. The national miniature alreraft tournament conducted by the Playground and Recreation Association of America will help direct this enthusiasm in a practical way and will help insure the future air supremacy of the United States.

-Communder Richard E. Bred.

ITERE is a real thrill in flying ampliant models. It doesn't matter how old you are or whether you know anything about aviation or not, you can't escape the fuscination of the game. But first you have to get into it, and to do that we can think of no better way than to build the model illustrated.

Known as a hand-launched single-stark tractor monoplane, it is one of the sumplest yet most interesting models. It can be made more quickly than almost any other type of plane and the cost for materials is triling. It is, nevertheless, an appellant floor.

an excellent flyer

Building the model is much easier if you have full size drawings of the various parts. These you can obtain by sending for Popular Science E Montener Blueprint B2 (see page 106). The experienced model-maker knows well the value of having large drawings to work from, for the beginner they are even more essential, for he has either to draw his own full eize layouts, which is often

SILK THREAD,

PANO WIRE

36 x 18.

57.10

the hardest part of the work, or take advantage of blueprints such as those published as an anxiliary service for readers of Post LAN SCIENCE MONTHLY

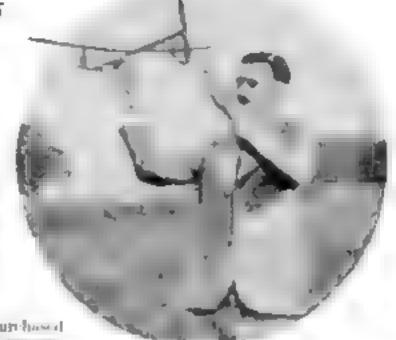
The fuselage of the model is a single stick of white pine 34 hy 44 by 30 in. Thus must be straight grained and sand-papered to a smooth finish.

First the propeller shaft hearing is installed. This may be purchased from a model supply company or year make it from a ½ in, long piece of ½ in, installe, diameter brant tube with ½ in, thick wall. The tube must be flared slightly at the front end so it will not slip back through the threads. Cut a block of white pine ½ by ½ by ½ in, and groove it along the top to make a crudle for the bearing. Gloc it to the top of the fuselage and bind the bearing in place. Before the glue dries, true the bearing up along the fuselage.

Make a rear righter hook as shown and

bind it to the fusclage.

The skid, or propeller guard is made from a piece of bamboo in by in by 7 m. It is bent, as shown, around the tip of the



Each above how to hold the 10-is, model when temperate a Both be and Bunch fly large as well as small emplance, for they are commercial aviators

propelier, then up to meet the fuselage 214 in from the nose, and then parallel to the fuselage for 56 in. Glue and band the skid to the underside of the fuselage. The skid brace, or front leg, is 1/6 by 1/8 by 1/4 in. It is bent parallel to the inselage at one end and to the skid at the other. It should meet the skid 31/6 in from the fuselage and should meet the fuselage 11/6 in from the nose. It is bound in place and gived.

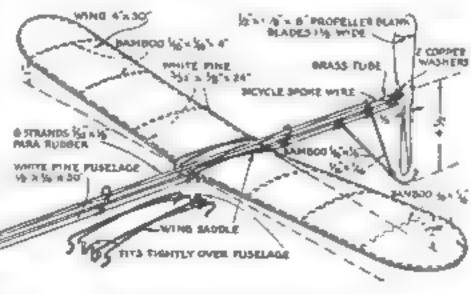
Bumboo is best by besting it over a carelle and forcing it into the

desired curve. Hold it that way for a moment until it cools. Whenever possible, bend bamboo with the glossy side on the

outside of the curve.

The "cans," or rubber guides, which keep the strain of the motor from distorting the frame, are made of \$\frac{1}{2}\$ in, diameter plane wire. There are two of these, one 7 in, and the other 18 in, from the mose, Loop the wire into a ring \$\frac{1}{2}\$ in, in diameter, bend the ends parallel to one another for \$\frac{1}{2}\$ in, and then bend them at a right angle to the loop for \$\frac{1}{2}\$ in. Glue and bind the cans to the fuselage.

The tail wing is fitted to the under-side of the fuselage. The spar is bamboo 1/4 by 1/4 by 10 iq. It (Continued on page 128)



How to Assemble the "Flying Stick"

The method of making the model and the principal dimensions are shown in this drawing and full size details of the parts are given on our Elucperat No. 82. This is the first of a new series of acplane models designed especially for Poyugan Scanege Mostracy that next will be a twin propeller reces

Powering Your Electric Set

How to Complete the New Popular Science Receiver with an Amplifier and Current Supply Unit Giving Maximum Volume

By ALFRED P LANE

N THE February bisne of Popular Science Monthly we described the construction of a new electric radio receiver. To complete this receiver you will need to build either the high power ampaßer and enerent supply unit to be described here or the lower powered. and less expensive unit to be described next mouth

This amplifier is the most powerful one you can assemble with apparatus now available to the home builder. It uses two \$10 tubes in a push-pull eircuit. and the volume without distortion will equal that of the hand playing in the studio, provided, of connic, that you use a good lendspeaker. The tone quality at superb. Low notes come through with out thumping or rumbling, and the entire. tacfal inustent scale is reproduced so that appared instruments or voices sound andoral and biebke even at tremendous

The construction of the amplifier and current supply out it shows clearly in Figs. 2 and 1, and the writing in Figs. 1.

In order to climmate the possibility of inagnotic interaction between the power transformer, the choke emis and the pushpall transformers, the instruments have been spread out on a long, wide bus-

THE complete electric act, consisting of the receiver described last month (Hhieprint 79) and the power unit deperitied here, is designed to fit auto a standactifactory made conside type cabinet or into the console cabinet made at home from Harpman 70 and 71. The receiver file in the upper compartment and the

power unit in the lower one ordinarily used for batteries.

The first step in the construction is to make up the baseboard. The one used on the out shown in the illustrations is 1934 in, wide and 46 in, long. This is as large a baseboard as can convenient. ly be gotten into the lower compartment of the console cabinet chosen for the set. Crosspieces should be screwed to the hottom of the baseisoard at the ends and in the middle to add strength and to allow room for passing some of the wires underseath the baseboard. Before fastening these pseces on the baseboard, be sure to drill a row of holes through them so that the wices can be passed through from one end of the unit to the other.

Blueprint Is Ready!

ORDER Blueprint No. 80 (see page 106). It will prove belpful in building this new high power amplifer and current supply unit. Many of the leaser details are included on the blueprint that could not be given here for lack of space. The Popular Science High Power Unit for Electric Radio Set and the receiver itself (Blueprint No. 79) have been tested and approved for home construction by the Popular Science Institute of Standards.

The three binding post panels can be made of shellacked plywood or from bakelity or hard rubber. They are mounted by means of long screws that pass through the aquall wood supporting

You will need these parts to build the high power amplifier and current supply unit for the Popular Science Electric Radio Set

A Power transformer with P2-volt #by volt, two 712 volt windings and a 730-volt winding tapped at 550 volts. B1 Choke code 20 bearies at 125 miss. H2 -chake cod, 50 henries at 30 mils.

C1, C2, C3, C4, C5 and C6 @mfd. condensers rated at 1000 volts direct current working voltage.

C7—1-mid condenses sated at 800 volts. CB and C9--1 mid. condensers rated at Hill volta.

Dt apput transformer

DE soutput transformer.

III -41,900-uhm beavy duty fixed rematurer, tapped at \$2,000, \$1,000, 10,-500, 12,500 and 0,000 and rated not less than 40 m la

Re--1000-ohm fixed reastance rated to carry not less than 50 mils.

R3 -25,000-ohm fixed resistance

S1, S4, and S5—standard X-type vacuum tube sockets.

Eight binding poets, flexible enameled fabric-covered ware, 1 1 Ne81 rectifying tube and two I N#10 amphlying tubes.

IT IS not necessary to use a baseboard made of one single piece of wood. The crosopieces permit you to assemble the haseboard from several pieces. The model power unit shown in the illustrations has a baseboard made up of three pieces which are firmly held together by screws through the crosspaces. Use boards 1/4 in thick. The marks are heavy and should be strongly supported.

Study the illustration in Fig. 2 and the picture wiring diagram of Fig. 5. They will show you how to place the apparatus on the baseboard. Note particularly the boles that will have to be drilled to puor the wires along under the baseboard. In the parture wiring diagram of Fig. 5 the solid wires are above the baseboard and the dotted wires are beneath it. The wiring is so ample and there is so unighspace that you will have no delically in following the dargrams without may upecal instructions. Remember that you are dealing with very high voltages and take

> special care with every conpection to make aura limit it m firmly moldered no that it will not come loose and cause a short circuit.

THE leads on the trans-fermer will be found long enough to reach directly to the points to which they are to be soldered except for the 754-volt leads that connect to the filament terminals of sockets S2 and S3, the center tup of this same winding. which connects to one end of R4, and the center tap of the \$15 volt winding, which gues to the 45-volt banding post by way of the 9000-ohm tap on R1 and one terminal of condenser C9. These leads from the transformer are extended by means of the regular book-up wire.

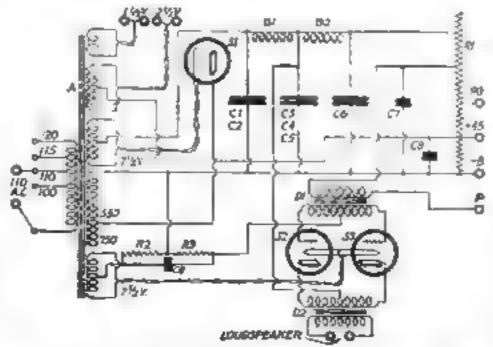
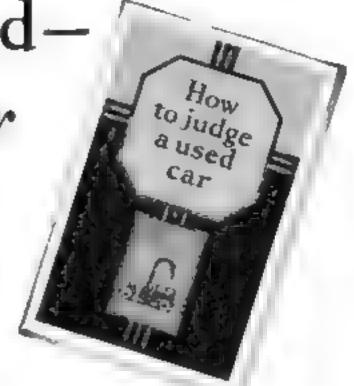


Fig. 1. This power amplifier and current supply unit can, of course, he mad as a last stage amplifier and H-supply unit with any type of battery operated set

"I material on page 8 er

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Figuring from the minus-B end of R1, the 45-volt hading post is connected at 0000 ohms, the 90-volt hading post at 10,500, the wire from one terminal of condenser C7 at \$1,000; and the wire from

condensers C3, C4 and C5, which are in parallel, taps in at 32 000 ohms. The 41,000-

volt tap is not used.

Before connecting the hinding posts that are used for the Light current supply to the primary taps of power transformer A, call up the office of the local power company and find out what the average voltage is in the lighting riscut in your neighborhood. Then connect the zero tap to one land og post and the next higher tap than the figure you get from the power company to the other hinding post. If the voltage in your locality

m nonsewhere in the neighborhood of 110 volts, for instance, use the 110-volt lead, and

NO OIL

The block of filter concensers (1, (2 and so on are held in place by a beavy copper were around over the top and another around them the other way near the base. This were also serves as a common name. It connection

Be fore to ground the cases of all tendensers and the france of transformer A and the chokes 111 and B4 This means that you

are to clamp a ware under one of the serews that holds transformer A to the haze-board and solder the other end of it to the manus-B were at my point. Do the same for the two chokes. You will find that the holding were can be tightened up enough to ground the cases of the condensers if you scrape a bright spot at the points where they touch each other.

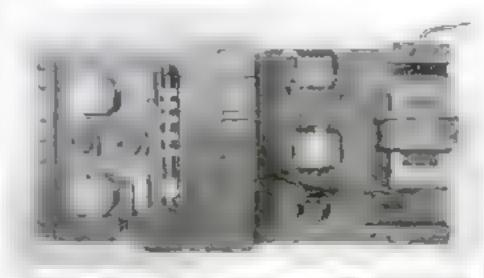
TAKE expected care to see that the 15% and 21% volt leads from transformer A are solidly connected to the binding posts. A poor connection at this point will seriously interfere with the operation of the outfit. Carefully tape the 750-volt lead

and the unused primary leads and push them down out of the way

After you have finished wring the unit and have reclacked your work several times to make sure that there are no errors, take a keyhole saw and cut out a large enough piece of the back of the lower compartment of the console cabinet to allow you to place the power unit inside. Leave the back of the cabinet open. These power tubes get quite bot and the opening will allow uit to circulate around them to keep them cool. If the tubes are

operated in a closed compartment, the excess heat will shorten their life.

Assuming that the radio receiver described last month is in the upper compartment, drill holes in the floor of the



they a The house of a series and series of managerine interaction

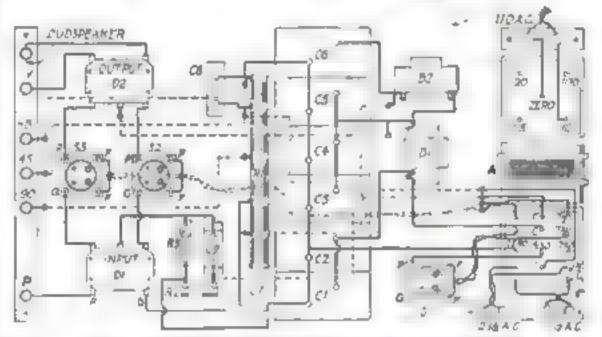


Fig. 3. Follow this picture diagram in wiring. The heavy black lines indicate there above the baseboard dotted lines, indicate those below. The crids of power transformer A have been turned so that connections are clear

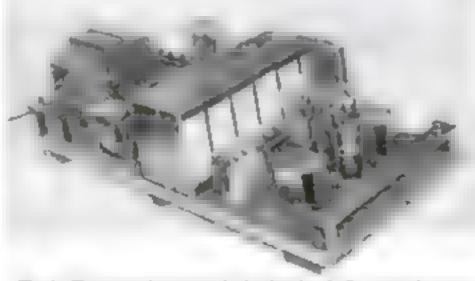


Fig. 4. Three erospieces runs the hearboard and ellow coops for wresunderments. Drill holes for the wires before you acrew on the erosponent

upper compartment so that you can pull through the leads from the receiver and connect them to the similarly marked hading posts on the power unit in the lower compartment. Leave the leads long enough so that you can pull the receiver out of the cabinet far enough to take the covers off the shield boxes.

Now most I'X > 6 tubes in sockets G1, G2, G3 and G5 of the receiver and put a 1 X227 tube in socket G4. Then put a 1 X281 tube in socket S1 of the power unit and insert 1 X210 tubes in sock-

ets S2 and S3 of the power amplifier. Connect the antenna and ground and the loudspeaker to the binding posts provided on the set, and then plug the cord

from the power unit into the nearest electric light nocket. The UX 281 tube should light to a duli red and the 210 tubes should glow quite brightly. The 286 tubes light about like the 281

and after thirty accords or so the 227 tube will also glow

If EVERYTHING has been done exactly according to instructions, you will hear a noticeable hum when you first turn on the current. This hum will continue t is the 227 heats on, then it will die out to a very low figure, so low that you will not notice it at all unless you tasten for it in a quiet room.

If all the tubes do not light

as described, shot off the current at once and do not turn it on again until you have definitely located the trouble, (aution' Never touch any part of the power amplifier and current supply unit while the current is turned on. Never attempt to operate the autili unious the specified tubes are in oll sockets. If, for instance, one of the #10 power amplifier tubes in sockets 5% or 88 should hura out, turn off the current at once. The receiver would operate with only one \$10 tube, but the tube would be

severely overloaded, the plate of the tube would get redhot and be destroyed in a

very short time.

All operating voltages are fixed. There is nothing to adjust in the power amplifier and current supply unit. The values of the various resistances are such that the radiofrequency susplifier tubes opcrate at 95 volts with a Cbias of 6 volts and they draw close to 3 mils each. The detector tube gets 45 volta Bcurrent, and the first and o amplifier tube has 175 volts applied to its plate with a 18-volt C bias. It draws 514 mils. The 210 power tubes operate on 450 valts B with a C-bas of 35 volts and they draw 40 milliansperen.

The only adjustments you have to make are in balancing condensers C4 and C5 in the receiver, and you have to turn potentiometer E5 to the point where the hum is lowest. This latter adjustment has to be made in a quiet room with the loudspeaker fairly near your ear.

too must make yourself a special screw driver to adjust condensers C4 mail C3 in the set. This should consist of a piece of wood slotted at one end with a washer or other this piece of metal forced into the slot and (Continued on page 116,



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CH FO 1987

How to Care for Your Tools

Hints on Sharpening Chisels, Planes, Gouges, Scrapers, Auger Bits and Saws

By CHARLES A. KING

OME workers and manual training pupils often seem to think that time spent in sharpening tooks is largely wasted. They prefer to "put to more strength," in the words of the Biblical philosopher who wrote: "If the iron be blunt, and he do not what the edge, then must be be put to more strength but wisdom is profitable to direct" (Eccles, 10.10). Even apprentices are well advanced in learning their trades before they attain wesdom in the realisation that time spent in sharpenting tooks will be more than repaid in the quantity and quality of their work.

Our discussion will be centered around wrockworking tools, for they are more commonly used in the home workshop than others. A bench grinder (A, Fig. 1) with a 6 by I in, whoel will give sainfactory results in sharpening all woodworking tools and for general grinding. It can he converted to a foot power grinder by adding a treadle, which allows

both hands to grasp the tool. A combination oilstone or whetatone B, I by 2 by 6 in., coarse on one aide and fine on the other. which is set in an iron or wooden box to prevent the cutting surface from becoming glased with dust, is an excellent general purpose stone. A strop 1 made of a piece of leathglord or tacked on wood, wmake a keen edge a little keener.

Slip stones similar to those shows at D are necessary if gouges or carving louis

are to be altarpened.

From the time our primeval ancestor discovered that a broken bone or a claimshall could be worn to a cutting edge on a flat stone, the kinfe has been the universal tool. For general use the knufe may be sharpened as at A, Fig. 2, but a knife for whittling should be similar to B. Lay



To enjoy fully your home workshop you must have gord tools and leep them well sharpened

the kir fe upon the grandstone tangent at the edge as at C and turn the stone toward the edge. Move the knife forward occasionally to maintain a nearly straight a rface from the edge to the back. Reverse hands and grind the other side. keep the knife moving back and forth the entire length of the edge to prevent heating. When a wire edge or minute burr turns over, the edge is finished.

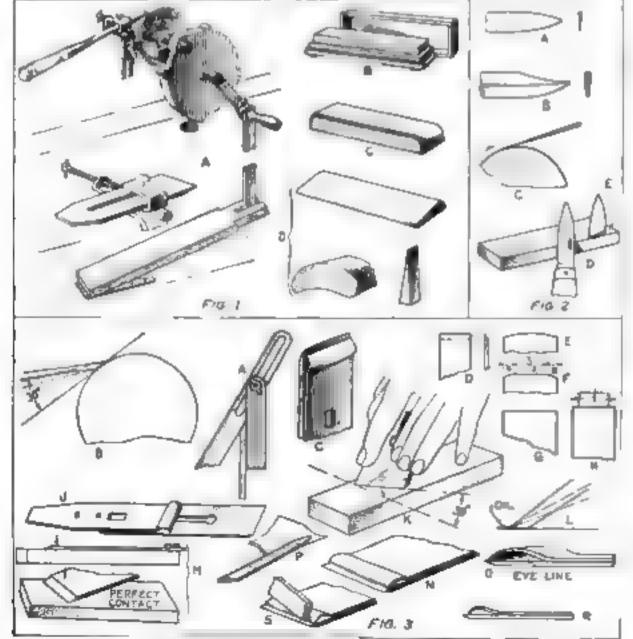
LAY the lands on the whetstone as at D, pressing lightly upon the cutting edge so the back edge will clear the stone a very little as at F. Remove the wire edge by drawing the knife across a piece of wood and give a few more atrakes upon the whetstone, finishing upon the strop, d deared.

Workmen seldom think of the bevel of a cutting tool in degrees; they are guided by the eye and the "feel" of the tool. A rather thin edge is preferred in working soft wood, while a somewhat thicker edge will stand up better on hardwood and for general purposes. A thin edge in bester for a paring clusel, and a thicker

edge for a mortaing chieck

In deference to definition we must mention an angle, most cutting tools are ground to a 95- or 50-degree angle. Set a bevel at 30 degrees and test the bevel of a plane cutter or clusel as at A, Fig. 8. It is unportant that the bevel be true the entire width and thickness of the iron. though the pemphery of the wheel will make the bevel a little bollow as at B.

The beach grinder may have a tool rest that can be moved from right to left. in which the tool may be clamped as shown in Fig. 1; thut insures accuracy. I sually the professional mechanic prefers a stationary rest and guides the tool by holding his fingers in one position against the rest. When grinding a plane cutter, set the cap iron back from the cutting edge about 14 in. as at C, Fig. 8, and use it as a guide for squareness instead of testing (Continued on page 126)



For heaping your tools in condition you mad a bench grinder, a whetstone, a strop, and one or more slip states, so in Fig. 1. Methods of sharpening baives and plants are illustrated in Figs. 2 and 3



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Tricks of the Toolmaker

How to Lay Out Work Quickly and Accurately on Lathe and Milling Machine -Jigs, Fixtures, Piercing Punches and Dies

By HECTOR J. CHAMBERLAND

but machine shop work, although they may appear to save time, are often lacking in either accuracy or practicalulaty.

Anyone familiar with this line of work will adout that the method of using movable buttons is hard to best so far as the average abop is concerned. Manufacturing plants engaged extensively to making jugs and the like are always on the lookout for production engagement and use jug boring

on which the spacing of any the versier system so that ever the errors are practically eliminated to be ordinary shop, however, has to be ordinary shop, however, has to be ordinary shop, and a milling machine.

A practical and accurate method to lay out work is to finish the piece to standard dimensions, granting it if necessary, and use a nort parallels clamped or acrewed to the sides, as in Fig. 1. This method is excellent in such work as matching pieceing purches and dies.

An example authorize in Fig. 4, page 108. It is a piercing princh and die for hack saw backs. The boring is done in machine

a rat tes un l'agretation,
a rata de l'encolprac
, un l'es l'un res sant

plates a these are used the work class and allow the use of clamps to hold the parallels

for measuring small holes are drilled and tapped at convenient places. The parallels may be of any length, if accurate,

A good lathe may be depended upon to execute accurate work. Before boring in the lathe, one must exercise care in strapping the work to the faceplate and have it well balanced. Should the work shift

slightly, the deviation might be in any direction, whereas if the boring is done on the milling machine, the work has very little chance of changing position.

Figure 4 gives an idea of an operation well fitted for the imling machine. The holes are located, dulied and borrd in in smaller than their finished size and tested with the parallels and a plug gage. Corrections if necessary are made with the and of the dial indicator.

In this case the work is

Fig. 1. When become are a the mild that we have not be inside as the inside of he in the inside of he in the interest of the parameter are so and self-the work as when he have not in the inside he was because in the first of the inside he was because in the inside he was been as the inside he was because in the inside he was been as the inside he in the inside he inside he

Fig. 2 merow. Trong is a hinter than a different part of the second part of the second part of the second part of Fig. 3.

HANDWHEEL FOR ORAWING
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M COLLET PATTED
TO LATINE SPRING

Fig. 5. A spring-actuated center for a lathe, which seven time in focating work that is to be clamped to the inceplate for having

accurately squared and strapped to the table. The vertical fixture also should be set with the indicator, using a 34 in. cylindrically ground piece.

Provided the equipment is in good condition as a whole, no trouble should be experienced in spacing, and the boring can be done without any previous layout. A start is made on side A. The back lish is climinated at all times and a piece of 001 in, thick paper is used between the inde and the plug gage in the chick. The .625-in, spacing of the No. I hole is first taken and the work continued towards aide C, repeating the operation as before. After the holes have been bored to % in, and checked with a ping gage and parallels, the micrometer will show the accuracy of the machine.

If the location is off in either of the four directions, the (Continued on page 108)

OTHER timesaving shop ideas are contained in the continuation of the BetterShopMethodsDepartment, which you will find on pages 98, 108 and 110.



Short Cuts for Machinists

A Simple Way to Use Gears for Indexing Work on the Grinder— Depth Gage for Lathe Drilling—Extension Tool Holder for Planer—Universal Joint for Floating Reamer—Other Shop Kinks

Fig. 1. A gent used on a grinder to under milling machine cutter bends.

IT IS often necessary to grand undexed work, but as a rule no adequate or universal indexing fixtures are available for grander work. It is not advisable to use a nultrig marchine index lead on a grander story it is likely to be injured some.

or later for accurate work on the miller. It is also much too heavy for convenience

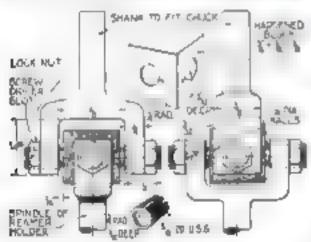


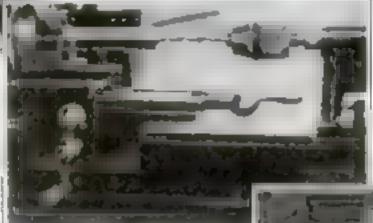
Fig. 6. A universal joint for a flusting reamer и и made of machinery sizel, pack hardened

The suppost occurate method for in a versa, indexing is to make use of change gears such as are supposed with universal malers and with engine latins. With these practically any required division can be obtained. Figure I shown a case in said. Several cutter heads for nothing purposes were ground by using a gear for indexing and a spring fuger to lock it in position. O. S. Mainer via.

Will's delling a job chucked in the lathe, such as, for instance, the one shown in Fig. 4, it is possible to rig a gage to indicate how far the drill has penetrated. A strip of sheet metal is secured to the drill chuck with a rubber band, and the end of the strip is lined up with the end of the drill and bent so that it just clears the work. The required depth of hole can be marked either on the gage strip or on the job itself. The idea

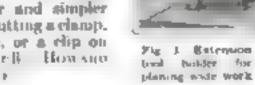
might be carried further by using, instead of the sheet metal strip, a narrow steel rule, perhaps with a spring clip to hold it on the chieck

When the job is of such shape that the gage strip will not past over it wisle rinning the strip can be bent down until it touches the drill, and set so that the end is exactly the depth of the hole from the point of the drill.



Pig. 2 A strip of sheet metal and a cubber band form this drilling gage

in practice this plan has been found queker and simpler than putting a clamp, a tube, or a clip on the della Howane.



HOW to overcome the handsup of an old style planer with only a norrow opening between the homonium in illustrated in Figs. 3 and 4. A tool holder was made as shown so that the full stroke of the planer does not have to be used. The made of the tool holder was cut out with a torch to give ample room for bolting at in place. A Sansyan.

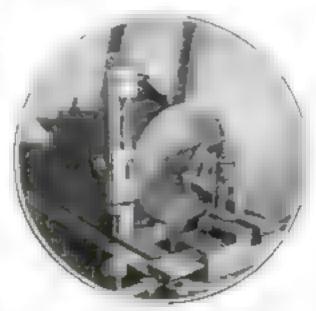


Fig. 7. A lathe indexing facure for drilling, cutting teeth and graduating work accountely.



Fig. 5. A cutting block for sheet metal with a spring grap to hold down the thin stuck

FIGURE 5 shows how a beach block was fitted with a spring grip arrangement to hold thin metal down at one end while it is being cut off with a chisel. Spring wire was bent as shown, the ends were spring into a hole passing through the block near the top and suit-

able coil springs were attached.—H M.

THE universal point so widely used in machine construction is also practical for floating reamers. In Fig. 5 is illustrated a joint that is easily adjusted to take up wear.

If J C

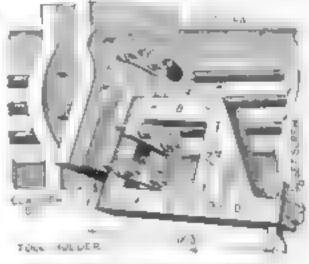
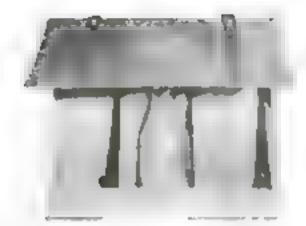


Fig. 6. How the extension tool holder is made. The large opening is cut with a torch

IN FIG. 7 is shown an indexing fixture. If for an engine lathe. A cast from or sicel disk 10 or 12 in. to diameter as cut as a worm wheel on its persphery, preferably with 500 teeth. This is attached to the lathe spindle in place of the regular faceplate. A right-angle member 1D, which is botted to the bed of the lathe close to the headstock, supports a screw or worm, and at the upper end is an index plate B, and a crank and "flipper" par C. This index plate, in conjunction with the large worm-wheel plate, provides for almost unlimited indexing operations. O. M.



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How to Lay Out Your Shop for Decorative Metal Work

By EDWARD THATCHER

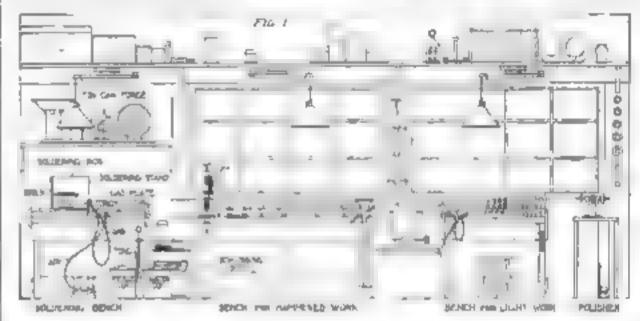
THE individual craftsman who takes up decorative metal work will, of course, adapt his shop layout to the space available, be it large or small. He may use benches and other equipment already in his possession provided they are in a good light. If there is only one window facing north, the best place should be given to the jeweler's or light work bench where one works seated.

blowtorch for use in handling hot work.

The pickle and water crocks rest on the floor. A small gas plate is available for heating pickle, drying out work for hard soldering, and even for certain soldering

The arrangement of this bench would be practically the same if a gasoline blowtors is were used.

I free al of more at liges an old kitchen



An ideal layout for a house workshop as he devoted to confluent in metal. The units may be pearmaged to test the floor space, but in any case the small territ should be united a window

A layout such as the one shown in Fig. 1, where the benches are all along one wall, makes for convenience when transferring the work from one bench to another.

Plenty of closet and shelf room is needed. A small case tilled with sliding drawers, such as the one shown above the bench for light work, in convenient for storing rivets, acrews, drills and the like supplies such as lump or powdered painties, charcoal, pitch, room and chemicals are best kept in labeled boxes. It is accoraginal plan to make a rack of some sort for sheet copper and brass. The high narrow boxes used for glass by glassess form excellent racks for flat sheet copper.

On the extreme left of Fog 1 will be noted the soldering bench, the top covered

onth a layer of brick.
On this bench stands
the soldering box to
which rests the soldering stand or turntable.

Near by is the blowtorch held by a special book fastened to the bench. From the blowtorch risks a ribber bose to the foot bellows for the air supply, the other bose goes to a cock on the gas line. A pair of tongs hangs on a nail near the

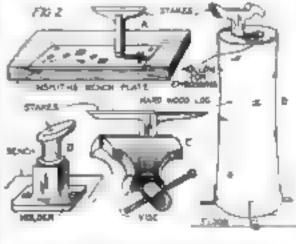
stove for a soldering bench the large flat near top making an excellent piace for soldering operations. The top of a sheet steel oil stove could be used in the same way after the stave bad outlived its usefulness in the ketchen.

ON A shelf above the soldering bench is a forge for light work. It is set down on the bench for supplementing the bent of the blowtorch when soldering or amoraling large work or melting metal.

The bench for hammered work should be constructed very solidly. Atthough suitable dimensions were suggested in another diastration of the bench published in the first article of this series (Novemter, 1927, issue), the width and length should be made to suit the space avail

able. The height of the top of the bench from the floor should be so planned that when a stake is in the visc you may do humonered work in a natural position.

Generally, the top of the vise awas hould be on a level with the chow or slightly below it. A bench top from 28 to 30 in, from the floor will usually give this beight, depending on the (Continued on page 129)



Pour ways to hold stakes for harmosted much. That shows at H is the least noisy





ORONA has caught the colorful spirit of modern times! Scarlet, blue, green, maroon, cream, lavender—there is a Corona for every decorative scheme. (And, of course, the standard black Corona.) When you buy Corona, you know you are getting the utmost value in portable typewriters—the only portable with a twenty-year record of satisfactory performance. More Coronas are in use than all other makes of portables combined. See these new colored Coronas at the nearest Corona store. Convenient payment plan.

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Scenecraft—The Exterior Set

How to Interpret the Playwright's Script-Sketches and Models -- Hints on Painting and Lighting

By ANDRE SMITH

In THE deagoing and huiding of an extense setting the amateur accidence weight finds humself up against a more difficult problem than may be has encountered in his experience with intenses. He knows well enough that he can create three walls of a room, but he stands in awe of the wall-less outside, where tree forms, flowers and atmosphere are perhaps the only limits to his set.

The problem, after all, is not so difficult as it seems. In the interior set the seenewright shifts off his back, and sidestage areas with three obvious walks, and in the exterior set he does the same, with this difference: the walls are not obvious.

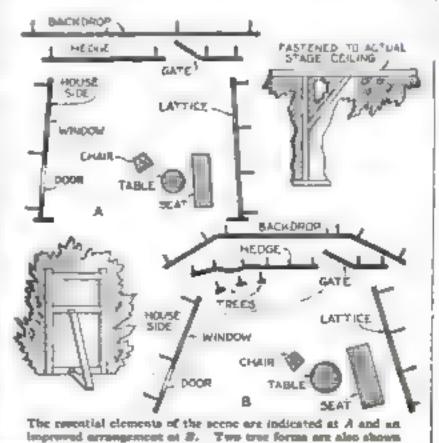
In its crudest conception an exterior set consists of a back wall in the form of a pointed back drop, and side walls in the shape of painted flats. As far as the exterior set is concerned it still remains, in spite of the healthy changes in the modern method of acene building, a matter of point and illusion. Amateur play producers who have organized metely with the idea of giving one play. and who have to build their settings with as little fuss and expense as possible, can have no great curtain of blue canvas (cyclorama) to encircle the stage. Whatever but of heavenly blue enters their actions will have to be done in paint on a back drop, and the actual stage cesting or a painted blue hd wall have to take the place of the infinite

spaces of the sky. It is too

bad, but it can't be helped. And no, facing our enforced insutations, let us tackle our problem with a stout heart and do the best we can.

In order to see how the thing is done but as set for ourselves an actual problem in seems designing. Let us suppose that the playwright's script reads as follows:

ACT TWO: The garden in the limitey home. It is one of those simple New Logland back vard pardens, the kind that seems to be self-created, in which flowers happen as if by chance rather than by some skallful paraeners direction. The wall of the finalley house occupies the right of the stage. It is a rear wing of the house and contains as entrance door and a window. Over the door is a simple shed roof supported. (Continued en soor 11)



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The Charm of

gloomy surfaces behind one or two costs of KYANIZE Celoid Finish. Ideal also for tirring woodwork and

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However Valences To a very like in Mind and the constitute beauty of the constitute beauty find in a story and any finishing segments with a many finishing segments with a segment of the constitution of the



Ship Plans

Ancient and Modern

THE plant for the ship models listed below are the result of years of Mr. Boucher a personal effort and atudy of Marine Models. For all years, since 1905, he has conducted his Model Shop where practically all the Marine Models made in the United States have been turned out

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You can but the mode plant of the ships flood better and be finite to proof type the parallelegic visited proof proof and plant plant properties of a company of the proof pro

Special Type Plane

		Over All	Period
Lucac Webb	offsele Packer Ships	40 Inches	
Managerie	16 At 10 h	E	1
Malena	1354s Chipper Ship	Mr.	
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4-4	(Free Amprilled Plags		
Ohio	74 Kjem	no uncluie	192
Maniter	Single Turrer Ship	In builds	1961
After instit	Grun Elad Steamer	S) Inches	105
Oregon,	Physic Residency	(1), (III, here	Clos
Burrie Centrer	Typical	10 Serpton	Malen
- Merci	hant and Historia	c Francis	

Firing Cloud Sanuggler a of Cappe stop at radios material will proper a for the America Half Aloon te disck hadama

And there are dozens of others tisted or the Catalog

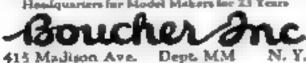
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This breakte the NoE MONE is true as suggested over the man and the results treaked to be a many to have all the later one. sections was a procured and all as characters at how a life continenative confin thing and parace global dops and invidends in other waar-

With even oper of ship one of states arranged on ne-pers are building by plan in a few oil with w booklet, 50 Mar 5400000, so of managed out he at Social fee your beautifule motivied up. It is it by early his by ecture mail, rostage region a

Gentlement-Enclosed at 13c for which please and me ob-besturnly your groups allowand buokles, SCALE 8000Ea.

Handquarters for Model Makers for 23 Years



Tools - Pride of My Farm

They Save Time and Money in Making Essential Repairs-My First Outfit and How I Added to It

By GARFIELD MACDONALD

WE FARMERS are confronted with a difficult problem. ranelecting took for our workshops. In the first place, most of us have not the time to spend in building things purely for pleasure; we hasld from necessary. In the second place, we are called upon to make many makeshift separation out turplementa and machines until parts come from the factory.

When I purchased my form it was supposed to be fully egupped. Well it did have all the farming entdenner to rendy for action, but the tools commuted of a few mats warmelines, g. Sow. Bisel B.

low grade bathmer with one claw broken. I purchased a few tools from time to time, being guided in large part by the hats of home workshop tools published in Post on Science Monthly some time ago. Now I have a complete set of tools which, beades being the means of saving me money, are my pride and joy.

My first outfit is simple for the hepreser and serves as the nucleus for the second and there outfile, so that the farmer can add to it from time to time until he has a complete set of tools. It is

Par punch.

hence tool

Unblund

was tile 6 in.

Flat file, 8 in.

Pipe whench, 18 up.

St. na ing hutchet.

Load cheel, 13 th Larmers stylcher

and report staffit.

Piers, wire outling

as feelows Spire level thin Hale 24 thresfeld film french has mer-But het I i brane Ditalia di Allande Hand saw 21 to 8 projection representation Charle 1 to 4 1 m Screw dir ver-Fro. square come

headam type This set is inexpensive and in the bands of a man with a alight liking for repeat work will serve for an astonishing variety of jobs. For the accoud set my choice comprises all the first set and the following looks:

Leather punch, 4 htts Sela nolled adjustable wreuck, 8 m. Taper saw files, 🥳 dog,, amorted. Flat Bles, 🥍 dow., amorted. Half-round word rasps, 3, assorted Hand file for resper blades Breast drill, ratchet

रावे लाग Draw knife, 10 in. Screw draver hit. Bits to complete set from 14 to 1 in. by 16ths Machinist's hairmer, 14, lb. Block plane, lever adjustment Glass eutter Soldering out fit. Steel aquare, 2 ft



Every farmer needs on assortment of good tools because of the variety of early he has to do in repairing triplements and machines.

Bound shank dealls. B O h di Sharp pose patern Botol 19th pack was Hack onw blades, 12, natorted lengths Tool grander Saw act

Theve lock hammer I've bott jawa filth war margine) Hand saw, 20 in., 2 or # points Rip mw, 26 in., 4 poteta

With this set a farmer can make difficult repairs on machinery, erect buildings, and do countless repair jobs. While this is a representative assortment, it is not supposed that the list will be adhered to strictly, it may be modified to suit any apectal needs.

The third set consists of tools of the first and second sets with the addition of the following. The forge enables a man to make even difficult metal repairs on

inucl mery

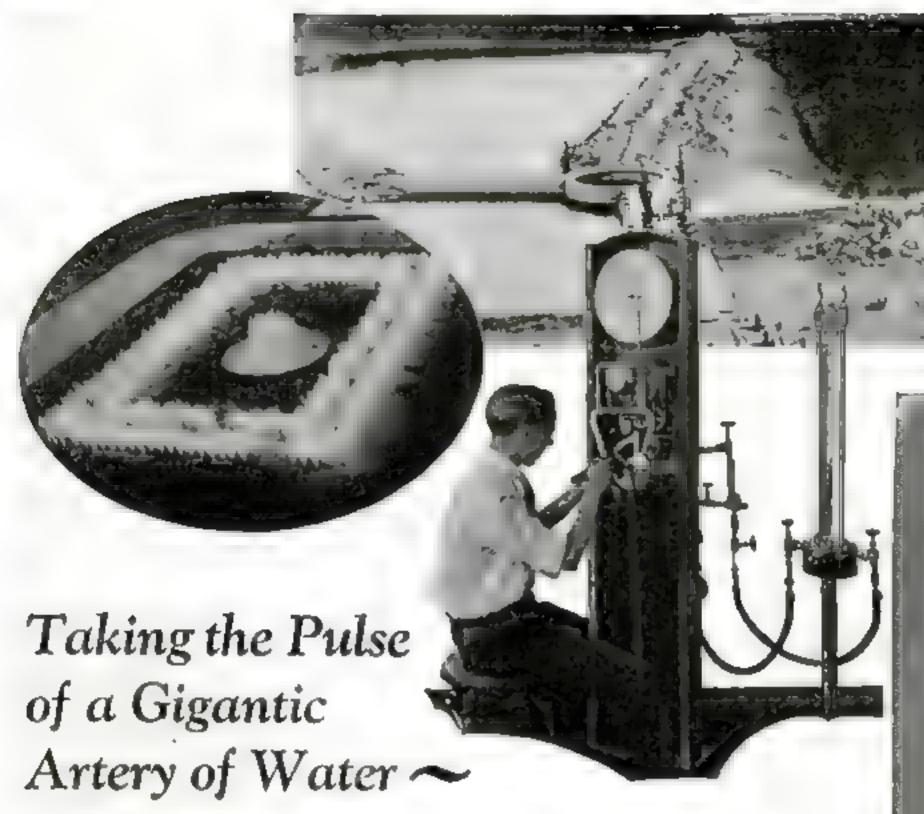
Mittee turk

Tape line, 100 ft.

If we counterank Secoth plane Hanwtorch Carpenter - pincers Experience off Cold Tusers, 15 doil, asserted Hand drill and set of July: Chuels, 54, 114, 4 in. El Housepattern palarers Tap and lie set, 17 a to plant Forge, 22am hearth. Anvel 75 bu

Farrer's hammer Blackage the harmmer # 'u lba. Bolt tongs blewight op tonge Blacksmith a puncers, 12 in. Former a knowle Martine gage Spokeshave Floor scraper Tin antpa (have houst himket breach set. Valve grinder and puste Hedromelet Five manute vakanmer

Погас тамра, 🕏 I always have on hand in the shop a good stock of hard and soft wood, strap and bar iron, nuts, belts and washers, glue, rivets, screws and nails, belt lacing and harness leather.



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Latine & Rev. Co. Historiand, Va. Centlement

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I had no other choice, so it seems, but to return to the most entadert by page tobasis that I have ever experienced. That friences is super other than the Edgeworth tobasco.

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Discovers Tobacco Wood Turning Simplified

Choosing a Lathe-Spindle Speeds-How to Sharpen Gouges and Chisels

By HERMAN HIGHTH



Fig. 1. Thumb-nell test for a chief; if it "takes hold," it is really sharp

P YOU have a hobby, you may consider yourself fortunate in this age of speed and mental strain. An interesting hobby takes the mind off business problems, gives it a rest, and tends to keep it healthy and normal. Modern psychologista, medical practitioners and educators stress the value and importance of developing a hobby; indeed, it is

one of the frankly avowed aims of manual arts instruction in the schools of today.

An ever-increasing number of men find relaxation in their bome workshops. If you are one of them, you can add greatly to your enjoyment and at the same time improve your cruft work in quality and variety by learning how to do wood turning. And this is not hard to do, especially now that such excellent motor-driven lather are available at reasonable prices.

There is an unescapable fascination

about wood turning. The shapes seem to form by magic under one's gouge and chisel. Pechape that is why lange and princes and even queens and ladies of high rank amused themselves by practicing wood turning during the seventeenth century Examples of their handwork are to be found in many European museums.

Simple as wood turning in, the beginner will make much faster progress if he takes the passa to observe the suggestions which will be given in this and following articles.

As a result of many years of teaching experience, the author will explain something that is really a great iteal easier than conventional wood turning. It is what might be called "wood scraping." This can be mastered more quickly



Fig. 1. The edges of acraping tools are sometimes turned over with a burnisher to form a burn or hook

and, generally speaking, is more accurate than orthodox wood turning. While it is not quite so fast. This is a matter of small importance from the standpoint of the amateur. Almost anyone can do accaping at once without the many discouraging and disheartening slips of the tool and consequent moilage of work so characteristic of wood turning practice.

Those who have learned or taught wood turning in the generally accepted way may disapprove of this method. In its justification, however, it may be stated

that pattern makers do all turned work on wooden patterns by means of scraping. If the method is effective in such necurate work, why is it not equally useful in producing turned parts for other purposes? Many manual training teachers will permit scraping in difficult places and on what is called faceplate work. Why not then be frank (Continued on page 100)

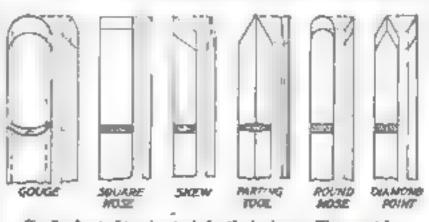


Fig. 3. A set of turning tools for the beginner. They must be supplemented by calipers, dividers, rule, silutone and slip stone







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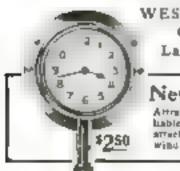
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Wood Turning Simplified

Continued from page 198)

about it and teach a method that will give the most pleasure and profit to the learner's

It is with this need in view that the following instructions, which have been traced out it actual school work, are given. The procedure is the mine whatever the size of the lathe and whether you are turning a condestick on a small motorized home workshop outfit or a table leg on a larger lathe such as that shown in Fig. 5, below. Note well the ammes of the various parts, for they will be mentioned repeatedly in the and following articles.

Fig. 4. A three chiefle is ground angularly

Selecting a lathe depends, of course, on several factors, our several factors, such as the type of work to be done, the space available and the price. The majority of the many small lather now no the market suitable for loose work are enupped with attachments for new-tog, boring, granding.

hoffing, mading and the like. A surpresent

her general wants orking and furniture making, it is well to wheel a lathe that is at least 30 m. bing between centers—the standard length of a table leg—and has a swing of at least 9 m. The height of the lathe center over the bed indicates the swing; that is the diameter of the stock which can be turned. If it at 6 m, shows the bed, the lathe has a 12-m, swing. Lathe hede of extra length min usually be obtained at a slight additional cost.

A motor-head lathe, that is, one with a variable specification mounted directly on the headstock, is the most convenient to use and taken up the least space. The more cumbout type of lathe shows in Fig. 5 is driven by means of a cone pulley belted to a countershalt, which has a similar come pulley and also a tight and loose pulley. The countershalt is generally fastened to the criting beams above the lathe. A small motor drives the countershaft and this in turn drives the countershaft and this in turn drives the countershaft and this in turn drives the inthe. By means of a belt-shifting device, generally constains of an use fork to which a wooden handle is fastened. The belt is moved from the boxes to the light pulley when it is desired

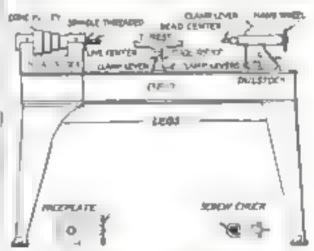


Fig. 5. A typical wood narning lathe. All lethes have subscaptially the same parts

to start the lathe. Sometimes a special motor is furnished with the lathe and is fastened to the legs below the headstock.

A lathe should run at a speed of about 2500 revolutions a assure when the belt is on the smallest step of the cone polley. If it is necessary to buy new polleys when installing a lathe, their diameters can be easily calculated if it is remembered that the diameter of the driven pulley times the number of revolutions

it makes is always equal to the diameter of the driving pulley times the number of revolutions it makes.

Suppose we buy a lathe with its corresponding countershaft and the cone pulleys have three steps, the smallest being firm in diameter and the largest 5 in. The tight and loose pulleys measure 6 in. in diameter. We have a bi-H. P. motor with a speed of 1900 revolutions a minute. The motor is equipped with a pulley 4 in. in diameter. Will this motor drive the lathe at the proper speed.

IT IS first secessary to find the speed at which the countershaft will revolve when it is belted to the motor

The revolutions of the motor multiplied by the diameter of the pulley equal the revolutions of the countershaft multiplied by the diameter of the loose pulley

1800 x 4 = rev of municrohaft x 6 4800 = 800 ± 6

The countershaft makes 800 R P M, therefore the cone pulley on the countershaft also makes 800 R P M. The problem now is to find how many revolutions the active quadle makes.

The revolutions of the counterdoft multiplied by the diameter of the large come pulley equal the revolutions of the live spindle multiplied by the diameter of the small cone pulley.

7500 = rev of live spindle 1 = 7500 = \$100 x 8

Stock not more than 5 in in diameter can be turned at the highest speed of the lathe (2000 If P M ,, stock from 5 in to 6 in in diameter should be turned at a medium speed with the helt on the second step of the cone pulley, and stock over 6 in, in diameter should be turned at the slowest speed of the lathe

Refere the stock is counsed off and runs true in the lathe, it causes a good deal of vibration. The lathe should, therefore, be run at a lower speed until this process has been completed, as excessive vibration may cause the stock to be thrown violently from the lathe

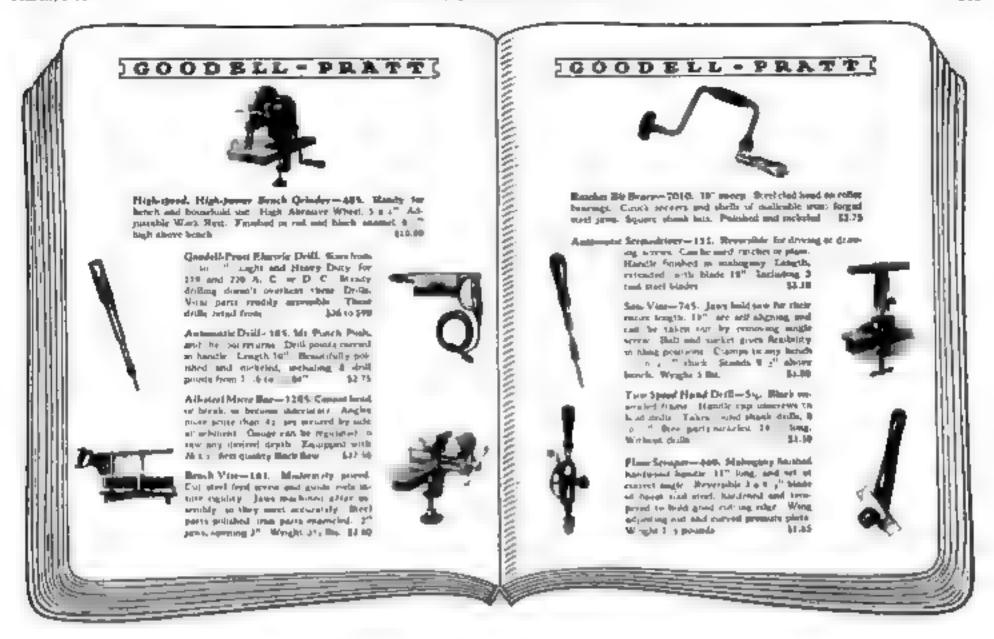
For the first in the work, the following took see Fig. 8) are sufficient. 1-in, gauge, \$4-in square-nose chirel, \$5-in, skew chirel, \$5-in, parting tool, \$5-in, round-nose chirel, \$5-in, simmond-point chirel, 0-in, outside spring caliper, 6-in, inside spring on oper, 8-in, wing dividers, rule, oil-toxe and slip stone

THE gauge is ground to semicircular shape with the bevel extending well around to the sides so as to leave no sharp corners as on the corpenter a gauge. The bevel should be about twice an long as the gauge is thick. It is ground on a sabdstone arms emery wheel If no water or kneesene runs over the stone, care should be taken to dip the tool frequently during the grinding process to prevent overbeating and drawing the temper of the steel.

Group the handle with the right hand, hold the blade to the surface of the stone with the left hand and move the gouge across the face of the stone with a rolling motion.

When ground, the gauge is whetted on an oilstone. The bevel is brought in contact with the stone and the gauge moved back and forth and simultaneously called from one side to the other. The wire edge, which is bent towards the taside by this process, is removed by rubbing the rounded edge of a slip stone back and forth over it. Keep the whole edge of the slip stone in contact with the inside of the game during this operation.

While the square-now turning chief lo longer than an ordinary chief, any common chief can be used in place of it if it has a long blade and is fairly (sectioned to rate 11.1)



GHE for carpentry tools presented here are single entropies of the eight in which each it made. The revologdistributes all himds of soois for muchinum, and proper Honol and ometeur me-

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Emp! Nothing simpler. The instructions are part like that from beginning to and the this and that from beginning to and the this and that and before you realize it a beautiful modal has grown before your eyes.

The model of the Mayflower is exact in every data.

detail. After you have completed building one of my models from the \$4.74 kit you will be \$4. well astished that you would not take \$50.00 or

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How to Fill Cracks Around Bathroom and Kitchen Fixtures and in Plaster Walls

By F. N. VANDERWALDER

EVEN the most carefully constructed house will suffer a little from the settlement of the foundation. Some cracks will open in the walls and the joints in floors, wood trun and built in ptemberg and cabmet fixtures. Furthermore, the shrinkage of lumber opens up eracks in wood trigg and in floors, such as those often seen about a fireplace and bracth of tile or brock. With the flight of time other defects become noticeable

These defects may not be serious, but they constitute eyesores. No one likes to be confronted with a number of radications

of wear and tear vet how to have their taken care of is a problem. The ales are too small for perphhorhoud tradesmen to be interested no. if they make such repairs at all, it is usually the result of repeated telephone calls mid much bother

Almost all such minor repairs can be done just as well by any person about the house as by a akilled mechanic, once the right ma-

terral and a little information are at hand landentally. Durg is considerable saving in both time and money to say nothing about convenience, in doing the job your-

In this and following articles the necewacy information for filling holes and eracks will be set down tenely. Materrals, tools and methods will be denembed.

> Bathroom Cracks

RECENTIONS which are butted close to tile and plaster walls.

sometimes pull away from the tile, leaving an unsightly crack. The actilement of the floor and the shrinkage of timbers in the wall are the usual causes.

To fill such cracks, the first step is to ent off all loose cement and sharp projections with a putty knife or acrew driver. Be careful not to dig at the surface so hard that the vitreous coating on the tub or wall will be scratched or clapped.

If the crack extends down deeply between the tub and wall, any filling of putty will drop down out of sight. Consequently, this space must first be filled to within an inch or two of the top with strips or wads of newspaper.

There are a number of materials that can be used for filling such cracks. A

dime s worth of plaster of Paris will do. Dump it into a clean can and cover completely with water. It will keep soft indefinitely as long as it is submerged. Take out a handful and knead it with your fingers until it becomes plantic like bread dough. Fill the crack with this putty, after first wetting the opening with water. Crowd the putty down well with a putty kmfc or spatula and smooth it off. Wape off the sucrounding surface with a damp cloth, and the job is done.

Such a filler, heang porous, will necumulate dirt and become decolored. To

> avoid this, coat the filling twice with white enamel or incuuer.

Another excellent filler is one of the prepared patching plasters, which come in dry form and can be bought at hardware and paint stores.

Putty mixed from white lead paste, dry whiting and a few drops of varnish or japan drier makes one of the toughest and best fillings for such

eracks. Such a filling will take two or three days to get dry, but eventually it will become almost as hard as stone. It is not a perous filling that will eatch diet. but a coating of lacquer or cuamel will make it still amouther and better.

Another type of filling is plastic paint, which comes in dry form. When wet with just enough warm water to make it stiff and plastic, it can be used as desembed for planter of Paris,

Crucks and other openings about kitchen sinks and lavatories may be filled in the same way. The enamel or iscquer conting is necessary wherever water is likely to be splashed on the filling, except in the case of the white lead and whiting murture.

Cracks in Plaster

This defects found m plaster walts are nettlement cracks at corners

and elsewhere, fine cracks, door-knob brunes, abrasions made by furniture, toys and other objects, and pail and screw

Very line cracks are not large enough to be filled with putty, yet when painted they absorb the liquid and show up as flat streaks much wider than the cracks themselves. About the easiest way to conceal these fine cracks is to coat them with shellac or var- (Confinued on page 105)



Placter of Puris, patching planter, and white lead putty are used to \$11 hathroom cracks

For the Handy Man Every Man-

PLASTIC WOOD

Handles Like Putty

Hardens Into Wood

HERE is wood that you can mould—a compound packed in air-tight tins so soft that it can be used like putty, but which hardens by action of the air into solid wood, water-proof and grease-proof, and adheres firmly to wood, metal, fabric, planter or stone. It is invaluable in the home, for the automobile, and with boats. A few household uses are shown here, but their number is unlimited and each day brings reports of new successes.



Loose Rungs

Pull out the rung. Becape hole to remove dried glue or dirt. Half fill hole with Plantic Wood and force rung back in. Clean off loose particles. Allow rung to set overnight. It is often advisable to hold rung fact with string while Plantic Wood

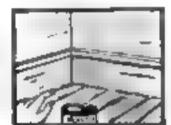


Scrape hole clean and fill around pipe with Piastic Wood, allowing the Plastic Wood to apread over edge of hole and slightly up the sides of the pipe. After the Plastic Wood hardens, trim level eround the pipe with a sharp knile and sandpaper smooth. Paint, stain or varnish to desired color.



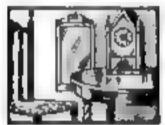
Baseboard Cracks

When the floor settles away from the baseboard Plantic Wood can be worked into the crack with the fingers or a knife and when hard, is easily sandpapered or pared smooth with a sharp knife, and painted or varnished to the color desired. Scrape crack clean before filling.



Loose Casters

Remove center and fill hole half full of Plantic Wood. Force center back into hole. Remove Plantic Wood that is aqueved out, and allow that to stand oversight before using.



Antique Furniture

Plastic Wood is widely used for repairing and strengthening antique furniture. Gouges can be filled, sandpapered and colored, missing decorations can be modelled-loose mouldings and pieces can be affixed; rungs and Joints permanently amengthened; drawer pulls made secura.

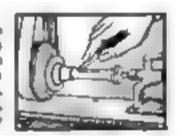


Plastic Wood is an invaluable sid in building model bosts. It is ideal for filling cracks, making tops and crossress secure to masts, fastening down deck houses, butwarks and fittings to the decks, sealing boles around masts and bowsprit, and for moulding figure-beads and decorations.



Wood Working

Piantic Wood is the one substance to antisfactorily repair mistakes or accidents in wood working, and its use will often simplify many tedioon jobs. It can be used for strengthening joints and corners, and when hard, it can be chisaled, planed, aswed, turned in a jathe and worked like intural wood.



Loose Handles

On brooms, mops, carpet sweepers, brushes toilet articles and hand tools. Remove bundle and insert sufficient Plastic Wood into bols so that when handle is forced back some Plastic Wood will be squeezed out. Allow handle to set well before using.



Locks, Latches, etc.

When it is necessary to move door locks, bolts or latches, Plastic Wood not only file up the old holes with permanent wood, but can be used to cover any scarred surfaces around the hardways. Bandpaper for smoothness, and point or varnish to the color of the surrounding surface.

Splinters

Cut off splinter from the wood and build up the splinter envity with Plantic Wood, working with fingers or knife. After hardening, candpaper or pare Plantic Wood to amouth finish, and color as desired.





Plastic Wood is carried at Hardware and Paint Stores, and by Ship Chandlers. It comes in natural wood color in 1 lb. cans at \$1 00, and in 14 lb. cans at 35 cents. For use in replacing loose tiles, and for cracked porcelain and enamel there is a special preparation, Plastic Wood White Waterproof Tile Cement, in 34 lb. cans at 35 cents.

Manufactured by The Addison-Leslie Company, 301 Bolovas Street, Canton, Mass.



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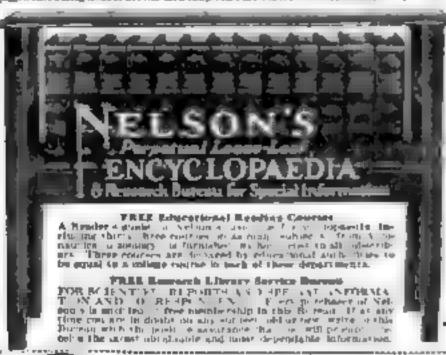
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The Shipshape Home

(Cast and from page 107)

nash and, when dry, to cost them with flat paint of any kind before paint ing the entire wall or ceiling. It is also necessary to stop up these fine cracks thoroughly when wall paper, canvas or other fabric is to be applied. The cracks will absorb most ure from the paste and the covering will not stick to the dry paste.

When the cracks are large enough to allow a lead pencil point to be inserted scrape the surface lengthwise with a but of broken window glass to cut off the lip that makes one side higher than the other, if there is a lip. Next, run a putly knufe or other sharp tool through the crack to make it as straight as possible and cut off loose projections from both rides. Remove all losse chips and fill the crack well with water, using a small brush; if oil putty is to be used coat the crack with linseed oil, not water

Probably the most convenient filling material is one of the prepared patching plasters. They art monly and adhere to the surface without skrinkage. When dry, amouth up with No tror No. 15 sund paper and cost with shelled before painting, calcumining or covering with wall paper or fabric. It is well, too, to coat the shellar with that paint before painting the entire surface, if it is to be painted

Other puttees can be made by adding dry whiting to any flat wall paint or to white lead paste thinned with a few drops

of linseed oil

All of the materials used for putty set slowly and allow plenty of time for the work, except plastee of Paris. A wool of that will begin to set in about five montes. after removing it from the water. It should not be used in that condition. A little dey whiting or hydrated lime as led to the plaster of Paris slows dow, its setting without injury to it, but do not use the vinegar or the ghie size sometimes recommended for that purpose.

Sealing Fire Cracks

WHEN a wall or ce bug occomplete. ly covered with a network of fine

"fire" cracks too small to be filled, it is too much work to shellae and flat-passt them. Other means are quicker and better. One of them is to apply a size coat consisting of one half first-class floor varnish and one half turpentine. Mix in also a little white lead or flat wall paint and a hundful or two of day, fine purpee stone

A second method is to use the wall with a mixture of one galling of boiled lauseed oil and one quart of turpenture In had cases it in well to fill the larger cracks of this type before the variable size. or before or after the oil aise, is applied. Thus some white lead-in-oil pasts or flat wall point a little with turpentine, run a stripe over each crack, let it set about

with a rag-

This is the first of a series of articles by Mr. Vanderwalker, who is one of the leading authorities on painting and decorating.

five minutes, and rub well into the cracks

Aren annumbed by fair and durin Cohomy and Aren

For Merit

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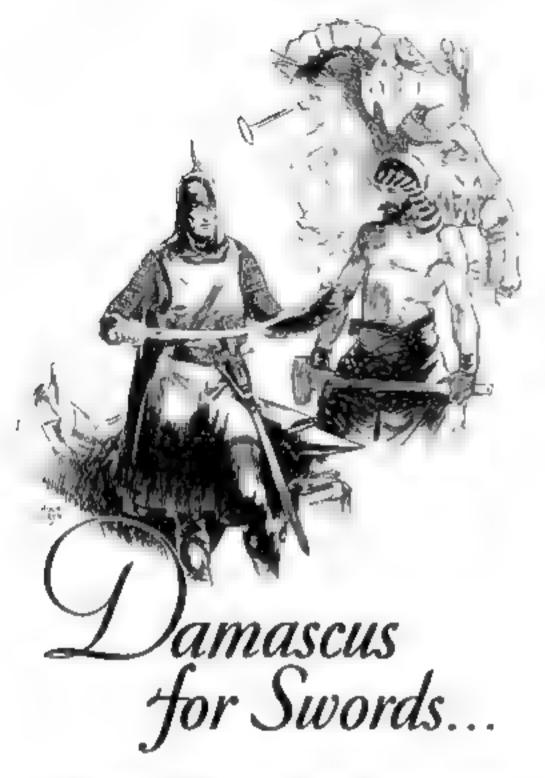


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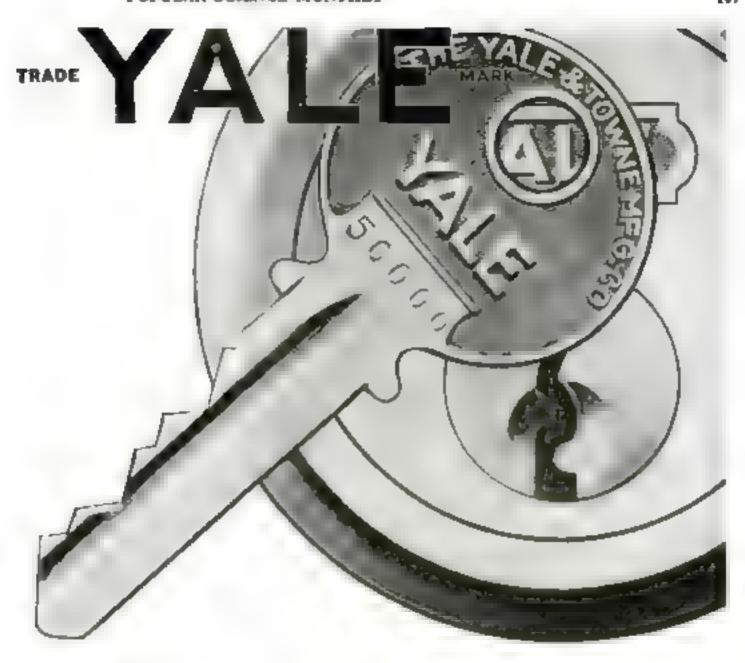
Send me the blueprint, or blueprints, I have underlined below, for which I inclose dellara

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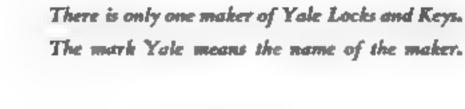
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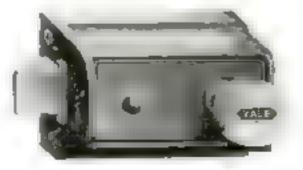


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When you wash your face, the air-

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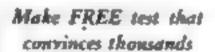
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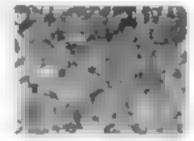
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Tricks of the Toolmaker

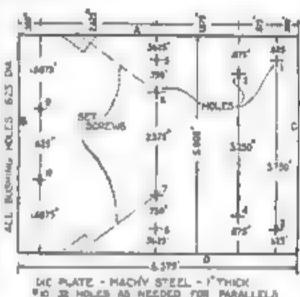
(Continued from page 88)

correction should be made with the dial indicator. This method will prove safer than relying on the dial on the machine, especially if the error is in the opposite direction to the last setting.

If the Kin reading proved to be accurate, the operator has no reason to worry. Nevertheless, every hole should be checked undersuc, which is much safer than the ordinary method of doing that before starting to bore by using the

plug gage in the chuck.

For hole No. 2 time is saved by coming to aide D and getting the hole accurate from the two sides. The S.750-in. spacing will prove correct because of the accurate dimension of the plate being bored. Moving back to side D, the .875 spacing is taken lengthwise. No. 4 hole is located. and bored, then No. 3 hole from side A, and so forth until all the holes have been located and bored.



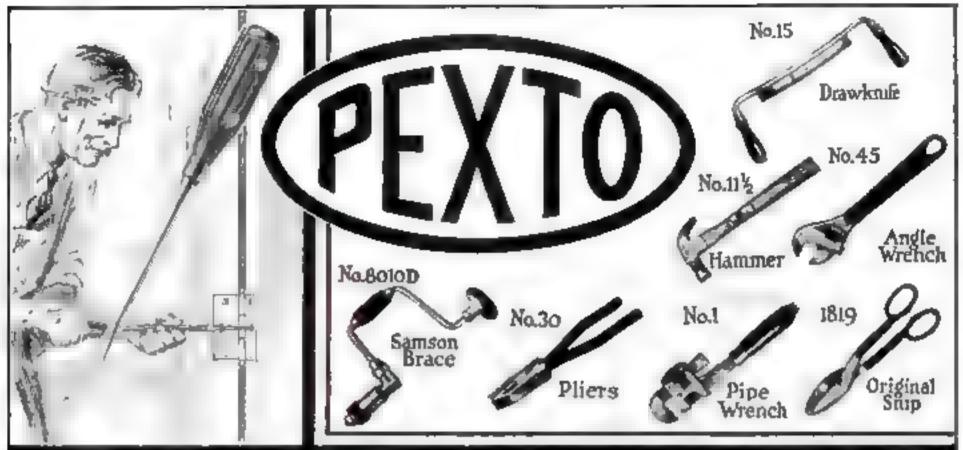
THE THE LOCAL OF THE PLATE. Fig. 4. Die pinter for a pierring punch und die med in mennfecturing heck was beche

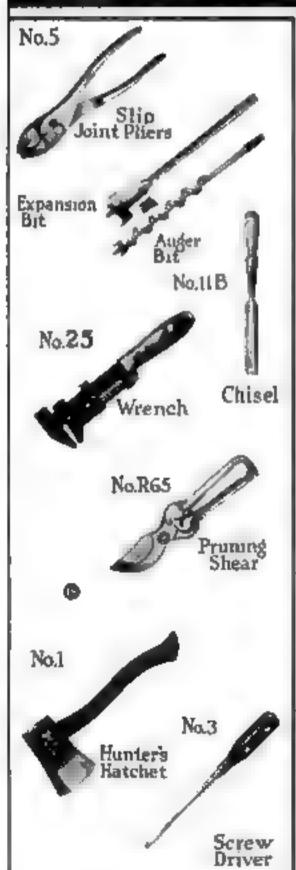
This may appear to be a very long job. but accuracy here is the main factor, as the stock punched out with the finished panch and die in bent perfectly central

and the holes must line up. The upper of the two drawings in Fig. I shows a job that can be laid out quickly and accurately by using four buttons at in Isrme.

Figure 2 illustrates the method of making a plate to be used as a distance testing fixture. The plate itself is shown in the lower drawing of Fig. 5. It is made of die steel, laid out the usual way, bardened and ground all over to exact dimensions. The .375- and 500-ph. holes must be accurate within .0001 in. The allowance for grinding, including the bolen, in .010 m.

The piece is surfaced off and squared: to size on the surface grander. The faceplate of the universal grander is ground square and the testing plate in clamped to it. The 500-in, hole is trued up with the indicator; it is then ground 0005 m. underage. The plate is removed from the mactime and the hole lapped a good fit on the .500-in. plug gage. The 375-m. hole is then plugged with a piece of soft steel. After the end of the plug has been requared, it is drilled and tapped for the movable button. The distance is now had out (Continued on page 110)





Tools You Need-

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High upon the roster of those who responded to the call of duty were the telephone workers. Operators in the danger zone stayed at their posts. Those who had left for the day and others on vacation, on their own initiative, hurried back to help handle the unprecedented volume of calls. Linemen and repairmen braved exploding shells to re-store the service. Within a little

over an hour emergency telephone service was established, invaluable in

caring for the victims and in mobilizing forces to fight the fire which followed.

in spite of repeated warnings of danger still threatening, no telephone worker left the affected дгел.

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Tricks of the Toolmaker

(Continued from page 108)

with the plug gage in the other hole. The plate is truck up again from the button and made secure on the faceplate. The plug, which should not be tight in the bole, is pushed out with a rod running through the spindle. The hole is then ground to .005 us. undersue and a test is made with a plug gage. If the distance is correct, the hole is finished to .0002 in. undersize and lapped. The small allowance for lapping this hole is reasonable on account of the exact hunts in respect to the spacing.

in many cases the boring is done in the punch and die holders instead of steel plates. The first hole in each holder is land out to match and the others are

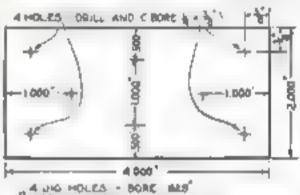
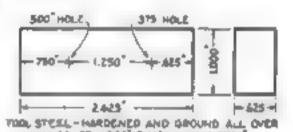


PLATE MACHY STEEL CAROLING ALL OVER TWO DIGES OF PLATE



CIMITS OF LESSO DIMENSION FOOD! Fig. S. A jig plate that can be laid out by using four buttons at a time, and a testing farture, which is shown set up in Fig. 2

spaced and bored from these individually. The post holes in the punch holder are generally bored much larger than the posts. After the punch and die are fitted in each other, the holes in the punch holder are babbitted, thereby mauring a perfect line-up of the entire job.

It often occurs that many flat pieces have to be bored in the lathe, nometimes two or three holes in the same piece, not necessarily exact work. These jobs are costly on account of the time spent getting the locations. By drilling these clear through and counterborne one aide with a medium-size center dull, and making a quark-locating center as in Fig. 8, much time can be saved. The tool will prove handy and will soon pay the initial cost. It is made of machinery steel, only the point of the center being caselurdened.

A collet in made to fit the lathe spindle accurately. A sliding center acting on a coil spring fits the bore in the collet. One end of the rod passing through the spindle is fastened to the back end of the center. the other end is threaded for a small handwheel. Guided by the center hole, the piece to be drilled is brought against the center and pressed to the faceplate. Clamps, which have previously been set handy, are tightened. The center is now drawn away enough to clear the work and the job is ready for boring.



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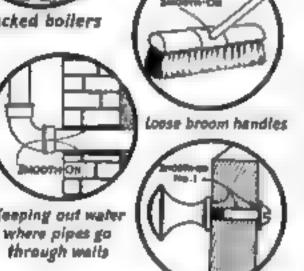
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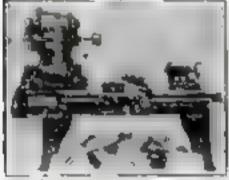
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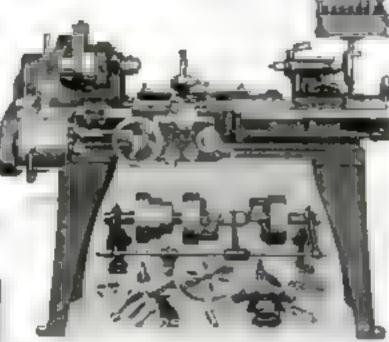
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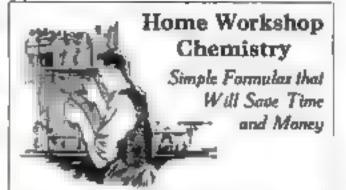
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SURFACES to be painted, whether wood, metal or composition, must be dry and clean. Any knots and sappy spots in woodwork must be covered with shellac. Cracks and depressions are first. painted with hosced oil and then are smoothed over with putty. Iron must be free of rust before it is painted.

It times it is necessary to remove the old paint before an object can be reparoted. The removal of paint on work of importance is untally accomplished with a commercial point and various remover, except in the case of house paint, which is burned off. Much cheaper than commercial removers at a morture of soft soap and burned and powdered lime (calcoum oxide), to which an inert material

bke sawdust, flour, starch or chalk is added. Thus noposities the point and varnish. loosening it so that it may be easily acraped off with a dull kurio or ectuper. The surfaces then must be washed thoroughly with water. The mixture stains the wood to a certain extent, especially any wood neh in

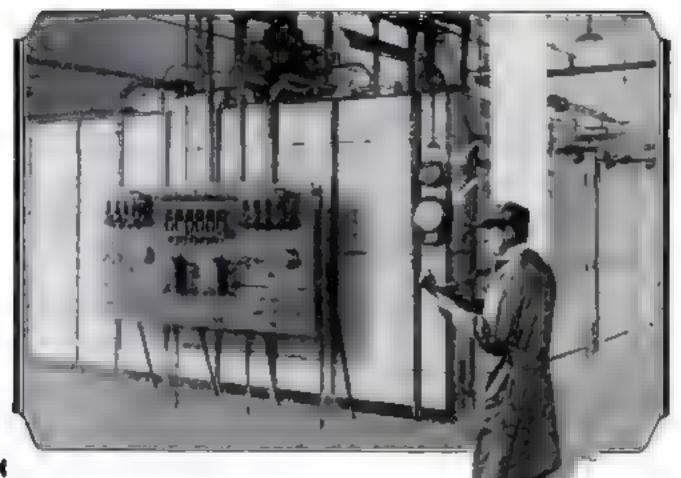


When white paint han a yellow Isnge a few drops of ultramering blue oil color in tabé talet will neutralize it

tautin like oak. That may be overcome, after the paint has been removed and the wood washed with water, by applying dilute talphure seed, made by pouring and stirring two parts of the acid slowly into eight parts of water. The send ocutralizes may alkali remoining in the pores of the wood, but it, in turn, must be removed by washing with water.

Other solutions, such as the commerrial removers, merely dissolve paint without affecting the wood in any way. The chemicals used, however, are more expensive and require two or more applications, especially if the paints are very Among them are the lighter petroleums, carbon bisusphide, acetone, wood and gram alcohols, carbolic acid and chloroform. Some of these are volatile, others are possonous, while others are combustable. Four formulas are

(1) Equal parts of acetone and carbon busilphide, with & on of paraffin added for each quart of muxture. The paraffin prevents too rapid evaporation after the remover has been applied. The maxture should not, therefore, be brushed more than is necessary, as brushing disturbs the film of paraffin. (1) Three parts of amyl alcohol and one of grain alcohol. (3) Four parts of grain alcohol, six of guaphne and one of amyl acetate. (4) Five parts of alcohol, five of bensol and one half part of amyl acetate.



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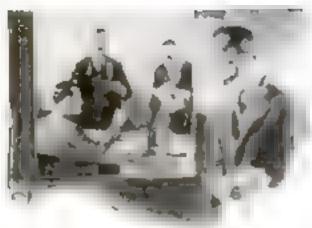
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Wood Turning Simplified

Continued from page 190)

heavy. To sharpen this type of chirel, place the beyel in contact with the nubtone, raise the chief and slowly move it back and forth, pressing on the blade with the left hand. Reverse the church place it absolutely flat on the oilstone, press on it with the left hand, and move it back and forth a few times. Repeat the process until the wire edge is removed. Test the sharpness of the teon on the thumbsail as in Fig. 1. If the iron is sharp it "takes hold , if it is not sharp, the next slides over it.

The akew chusel is ground so that two bevels are formed unstead of one. The cuttang edge should be at an angle of about 65 degrees to the side of the chirel. While granding, grasp the handle firmly in the right hand, press down on the blade with the left, and bold the chisel at such an angle that the cutting edge is parallel with the axis of the grindstone or emery wheel as in Fig. 4. Whet the chisel on the oilstone.

"HE parting or cutting-off tool has two w Till parting or cutting of equal length meet in the ridge that runs through the oof the blade. If they do not meet at this point the tool will bind and stook in the wood

The round-nose chuel is ground in much the same way as a gouge, and the diamond-point or spear-point chusel is held on the stone at an augle so that its edge is parallel to the axis as

shown in Fig. 4

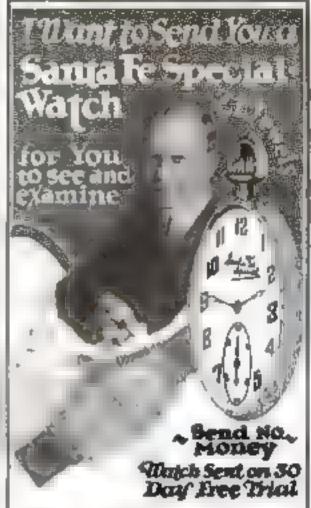
When a tool is used for scraping, its cutting edge dulls more quickly than when it is used for cutting. To overcome this disadvantage and also to make the tool cut better, the edge as sometimes turned with a buraisher to that it forms a sort of menature book or bure. This is done after the tool has been sharpened as explained above. A good way to turn the edge is to clamp the tool in a vive and stroke its edge with a burmsher. The first stroke should be at shout the same angle as the bevel. In the following strokes the burnisher is gradually raised, so that at the last stroke it is beld almost is a horizontal position, see Fig. 4. It. may be of advantage to turn the edge of squareand tound-note church and desmond-point chivels. The goage and slow chirel are cutting tools and abould not have their edges turned. neither should the parting tool, which has two bevels. The burnisher illustrated in Fig. 2 was made by grinding the teeth off a triangular

The oilst one and slip stone are hard smooth stones used for whething tools. Much ne oilthinned with increases is a good lubricant to une on them.

This is the first of a series of articles on wood turning. The second will describe in detail how to do simple spindle turning. In preparing this material for POPULAR SCIENCE MONTHLY, Mr. Hjorth has drawn upon extensive teaching experience. He is now an instructor in the Architectural Laboratory of the Saunders Trade School, Yonkers, N.Y., and formerly was General Supervisor of Manual Arts and Director of Tachnical Work in Porto Rico.

A wronger size horseshoe magnet in an aid around the workbench for picking up tacks and small nots and screws that have fallen into the mwdost and shavings. With the aid of the magnet a whole hox of tacks which have been spilled can be picked up quickly.—C B.W.

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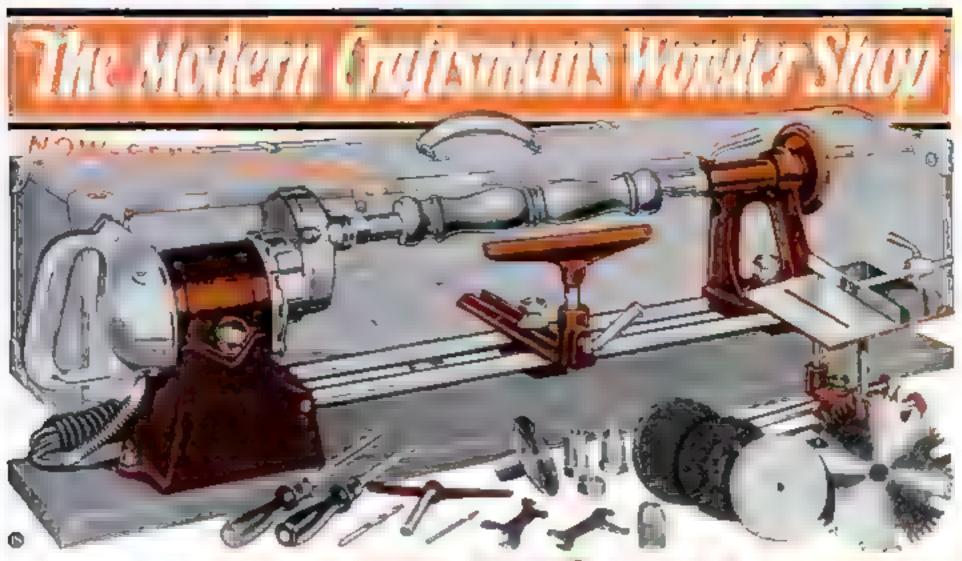
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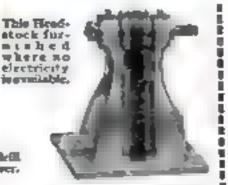






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Powering Your Set

(Continued from page #4)

filed so that it will fit into the slots in the serows. This strew driver is necessary for two transmis: First, it eliminates hand capacity and makes balancing much easier. Second, it prevents the chance for a short circuit that otherwise would occur if the blade of an ordinary metal arrew driver accidentally touched the shield or any other metal part while in contact with the screen on C4 and C5

To balance, turn the drums to about 30 and set them so that the squeal is as loud as possible. Put the top on shields N3 and N2. Turn the screw of C4 with the special screw driver until you find a point where there seems to be a radical change in the squeal—a fluttering or broken effect. Now put the top on N1 and take off the cover of N2. You, will find that by turning the screw of C3 you will come to a point where the squeal disappraise. If it does not, turn the screw in C4 a triffs, first one way and then the other, and again readjust C3.

IT WILL pay you to take your time shout the belancing and do if just as accurately as possible. As you have noted from the description of the electric receiver, the primary and of each radio-frequency transformer (Al, A2 and A3 of Bluepent No. 79) moves away from the secondary coil as the condenser in tuned to the lower wave lengths. In laboratory lests it has been found that the receiver is just as selective at the lower wave lengths as it is at the higher waves. This means, of course, that the tuning is sharp at the lower waves. Incorrect writing of the hillioning condensers (4 and (5 ma) upon the hillioning condensers (4 and (5 ma) upon the tuning on the short waves where a slight difference in capacity makes such a great difference in dial setting.

You may, for instance, get one balancing condenses set with a trifle too much capacity and the other with a shade too little. With such an adjustment you may find that there are two distinct points on the dial for such law wave statum. The remedy, of course, is to reset the balancing condensess until the double peak disappears

OMF there adjustments are made, von can push the set into the cabinet, for it will require absolutely no further attention until a tube gives out. As all these tubes are rated at 1000 hours of service, you probably will not have to touch the set except to turn it on and off and tune it for at least a year.

The volume control E2 will give you a perfectly smooth, distortionless control of volume on radio reception, but it has no effect on the volume with which phonograph records are reproduced when the phonograph pick-up unit is plugged into jack J. However, a special volume control is a part of the equipment that is melisted with the pick up device. To use the pick-up device samply turn on the set in the usual way plug into jack J and start the needle on the record. To amplify your own voice just plug a pair of her liphones into the jack and talk, into one of them. You can make up all kinds of special programs to amuse your friends by doing your own aphonoring and playing records for the masseal part of the entertainment.

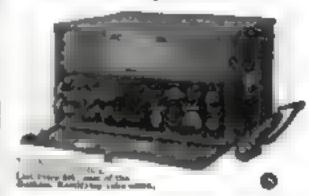
The Parts to Use

This high power amplifier and correct supply unit was designed without regard to expense for the racio fan who desires to build the linest possible outfit. In addition we wished to provide, as far as possible for feture developments that might make a still more powerful amplifier a practical possibility. This accounts for the 750-volt winding on the power transformer and the use of 1000-volt condensers in the filter circuit. Should a new and more powerful amplifier tole he brought out that required a greater voltage than the 810.

(Centimed in one Life)

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BEFORE you think of enother bety wited Amer Tran products will deliver smooth power to place and filament from the light socket, supplying sufficient voltage and current for push-pull 2.0 tubes and all other AC tubes required in a modern receiver. No batteries, liquids or chargem—no attention of adjustment necessary. This complete unit contains American designed equipment, with a power transformer having separate windings and especifies simple for practically any set.

With an AC power supply system or batteries, the fidelity of reproduction brought by the Amel Tran Push Pull Power Amplifier a actually limited only by the perfection of the speaker. Operated from the Amer Tran ABCH-Power Box, the input to the speaker is free from distortion and objectionable AC hum. The energy output is increased especially at the lower rousical frequencies, bringing greater clarity at high or low volume. The amplifier attaches to the distort of the receiver and is furnished with cable and plug to connect directly with the HI-Power But.

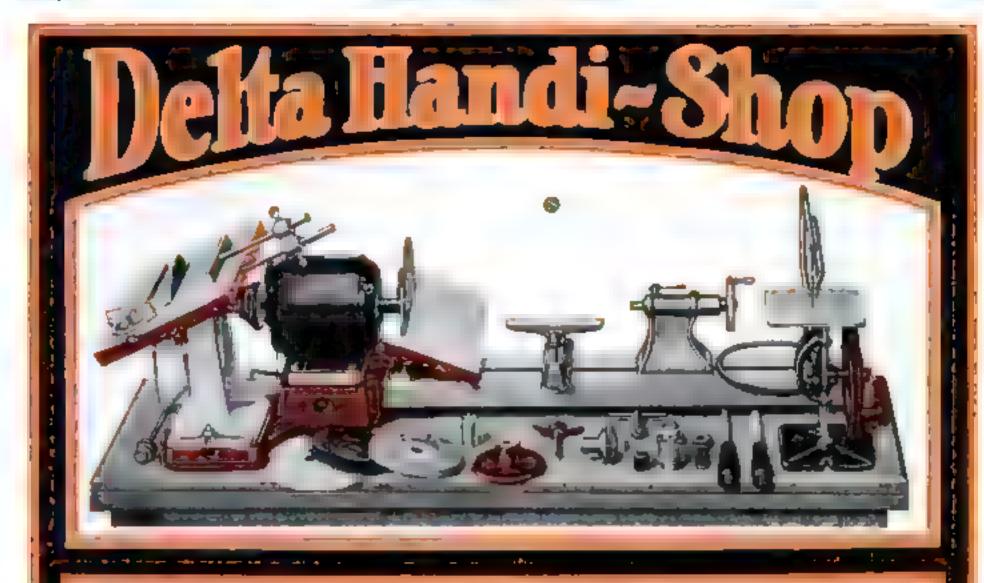
These two companion units are designed to work cogether, and with a good tuner and speaker will produce a philharmonic opchestra or pipe organ as though actually present.

See this test Amer Iran products are any more displaying the sign. "Author-lifted Amer Iran Dealer" or if you can not obtain them, write direct to this Company. Both wired units are licerated under patents owned or control by R.C.A. and must be sold complete with tubes.



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We have built real machine-value into the Delta so that you can do the insert kind of work on it with amazing rose.

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Powering Your Set

(Londonial Print, plan (18)

this outfit rould supply it merely by changing a few connections.

The power amplifier unit described here is, however, capable of such great volume with practically perfect tone quality that it is doubtful if any greater volume would prove of any practical value except in special cases.

It is quite possible, therefore, to materially

reduce the cost of the unit by using less expensive filter condensers and the capacity also can be reduced without affecting the tone quality to any appreciable degree.

The condensers 6.1 to C6 as listed, that 18, of it mid coposity rated at 1000 volts D.C. working voltage, cost as the neighborhood of eight distant aposce, which would make the cost of the necessary condensers for the whole unit approximately fifty to fifty-five dollars.

BY ELIMINATING condensers Ct, C4 and C5, you can save about twenty-five dollars. and a still greater saying can be made by using one of the standard block condensers specially designed for this type of circuit. Unreful taboratory tests have shown that while there is a elight increase in hum when the condenser cupacity is cut down, this difference is so small that it cannot be detected by the human ear These turious factors have been taken into account when making up the list of approved apparatus and the various types of condensers that are suitable for use in the circuit have been listed.

The reason that a 41,000-okin resistance is specified although part of it remains unused is because standard units of this resistance are available. They are tapped at the pusper punts. Fixed resistances have been specified at R1, R2 and R3 because the unit has been designed to work with the electric radio receiver of Blueprint No. 79. You can, of course, use this power amplifier and current supply and with any type of radio receiver, if desired. If you have a battery set, divegard the 1 y-and \$15-rolt windings. The bending post marked P of the power unit should be wired to the P terminal of the first notice amphiber tube to your set, thus cutting out the woord stage of audio Amphication in your set. Do not attempt to use the complete two stage audio amporter in your set with the power stage added to it. The combination is, in practically every care, absolutely approximate,

hour buttery operated receiver may require B-voltages differing from the electric set of Blueprint 70. If so, any desired B-voltages may be obtained by using at R1 a wire wound resistance unit fitted with clips that can be moved to change the voltage

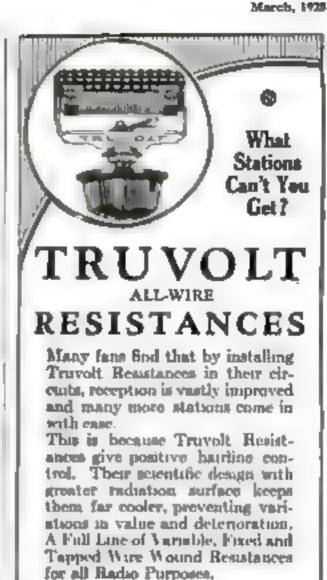
If any details of the construction, wiring or operation of the complete outfit are not clear, expans just what additional information you desire in a letter addressed; Radio Editor, Postava Screwe Moxestr, 250 Fourth Avenue, New York.

Toy Balloon Improves Blowpipe



A two-piece mouth blowpipe with bulloon attached to course a stendy, even blast of air

THEN you have work that requires the use of a mouth blowpipe, obtain one of the two-piece variety. Attach an ordinary ten-cent balloon to the large end with a rubber band, disjoint the blowpipe, inflate the balloon and reassemble the blowpipe. Then you will have a steady blast. T. M. Barroges.

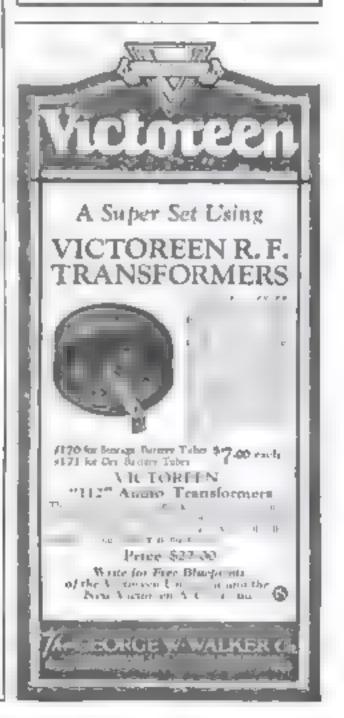


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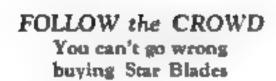


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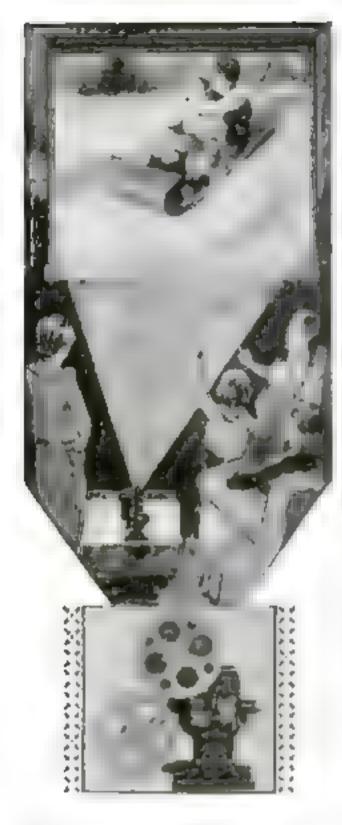




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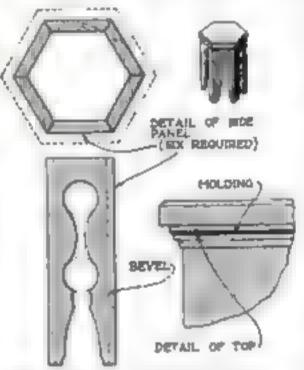
A Small Plant Stand Anyone Can Make

SMALL ornamental plant stand of A the type illustrated can be made easily by the amateur woodworker

While stands of this type can be any size, one 14 m. high, 01/2 in, across the top, and 8 in, across the base will be described. The wood in all 1/4 m. thick.

The core block, which goes just under the top, is insembed in a 614-in, circle. Draw the circle and, using the same radius, step around it with the compasses and connect the points with straight lines. Then now out the hexagon.

The mx pieces that are to form the hase may be heveled in one length and cut into sections that measure on the



How the sides are cut out and steembled and the top is trimmed with a stock molding

outside when finished 36 by 4 by 1316 in.

Yoy suitable design may be cut out with compass, keybole or feet saw. The one shown can be produced by borner two 214-in, holes and cutting out the remaining parts with a small saw, but the work must be firmly held in a vise or with hand screws to prevent splitting,

To assemble the base, place one section in the vise, apply liquid glue of good quality, and attach another section with two or three small bends. Make three pairs in this way. Now, keeping the core block slightly below the top, give and pail the parts lightly together. After the glue is hard, sandpaper the surface but do not round the edges.

The top is a hexagon unscribed in a 914-m. circle and is either maled or acrewed from beneath the core block, A stock molding is fastened beneath the top. If an adjustable unter box is not available, a small miter block may be made for cutting the angles.

If the stand were made higher and somewhat larger, the core block might be lowered several inches and the top hinged, to make a lady's worktable.

If made of hardwood, the stand can be stained and varnished or finished with clear brushing lacquer; if of softwood, it can be painted with colored brushing lacquer. A. E. ELLING.

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A definite program for getting about financially will be found on page four of this batte.

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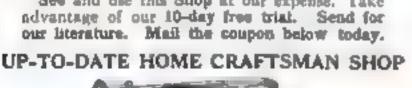
A Real Shop That Makes Real Things

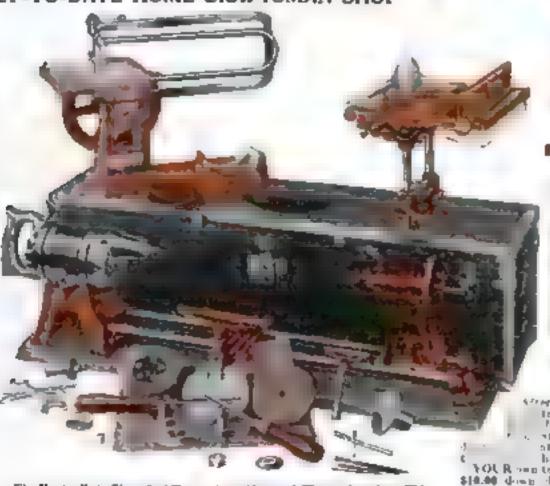
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You! Can make things too - Every man loves real equipment with which to build and repair things about the home and shop. Wood-work equipment was very expensive, large and bulky Now, anyone can afford to own our Craftsman Shop. Cabinet-makers, Home Craftsmen, Carpenters, men who use only the best of equipments have praised this shop which is the result of pertection in design and precision. "Make things the way they should be made, with tools that make them as they should be made."

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stationary dylling and sawing. This entherston of electricall complete in every driad, will make trop an advanced craft aman. Master mechanics have designed and stalled engineers has a constructed the entirphient which, after the pertin, its will agree to the best of its kind for those who build, a ent, evenir and congreged at home, it is unexcepted

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Above is small Set Back Ratchet Counter, which indicates one for each throw of the lever moving through an angle of 45 degrees. Reset to zero by one turn al knob requires very little power to actuate it. Applicable to a wide tange of light machinery Price, \$6.00. Equipped with lock and key to prevent tampeting with the record, \$2.00 extra-Amp furnished in a Revolution Counter.

The small Revolution Counter below reguters one for a revolution

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How to Lay Out Your Shop

Continued from page (12)

year mounted on it. As the vise as also used for many filing operations, were drawing, and many other things, the beight of the jaws from the floor should be excefully considered

The six legs are made of 4 by 5 in husber, the rest of the framework may be made of from I to La in thick hourds, d or 8 in water If the bench is to be a short one say 3 or 4 ft. long, four legs will be enough. The top should be of hardwood hereh or maple if possible, and 2 in or at least 1 . in thick

A strong bench will could if it is simply nailed together with heavy spikes; or the frame may be holted together, the top bring held with countermak lag screws. If you are food of woodworking you may make the whole affair with mortise and tenon joints, but it is not at all necessary

Each of the legs is firmly fastened to the floor with angle grows, and the bench should be also held firmly to the wall with angle itons, if

The plants forming the top should be litted together as tightly as possible and planed should be given one or two coats of builed oil. and the francwork painted some attractive

The leg of the blacksmath's box vise extends into a hole us a block of wood firmly fastened to the bench leg and floor. The you should be fastened to the bench top with heavy bolts, the front edge of the bench being note sed out, if necessary to receive a part of the back leg of the year. I bench drill is a useful tool to have on this bench.

Notice that the shop layout is planned so that there is room between the two benches: one may work at the end of the voc. standing between the two beaches, as one often finds it convenient to do when engaged in hammering out how is and trays.

The advantage of a blacksmith t vice in that it is made of wrought steel and is very strong. I misiderable pressure must be put on vise jaws to hold a stake firmly under repeated hammer blows, and the more finely made mactioneds, vices, while they may be used, will not usually stand up under the work, being made of cast steel or iron. There are many other uses for a heavy vise in the shop as will be noted later on.

THE beavier the vise is, the better. The The beaver me the part 6 in wide, and the whole vice weight about 120 pounds. I have had and used it for longer than twenty years, and we have tackled some beavy poles

Voes are usually sold and listed by the width of the paws parallel with the handle. If you huy a vier of the black-math - type, get one with at least 6-in jaws one with 5-in jaws is better, and one with 6-m pawe best of all. This hand of vice, if not sold by your hardware dealer can be obtained reasonably from any

Of course, if you already have a machinist a the of good size, you may use thu, or devise some other method of holding the stakes as down in Fig. 4. At A is a trasmith a bench plate such as you may have seen in a tinner a or coppersently a shop. This is a heavy slotted too plate with a number of restangular holes. or dots. It is let into the bench top, and the wood underneath each dot as cut out to correspond with the taper of these slots, so that the tapering ends of the stakes or unvils are heid very firmly. This is a very old and sales-factory method of holding stakes. Bench plates of this sort may be obtained from dealers in tin-miths supplies. It is well to get the entalog of such a firm, as you will find many

stakes, anvils and other special tooks for the use of metal workers.

Another method of bolding stakes is shown at B. It is perhaps the oldest and best method of all, if you have room for it. A large log or stump of herowood-maple or beech-is factened to the floor of the shop with angle from. In the top of this log, which is about 70 in. up from the floor, is cut one or several tapering slots to fit the tapered code of the stakes and hold them firmly for hammer work. That is the most noweless and inexpeneive way of booking stakes for making howpand trays. Many metal workers who live in the country have several of the logs set in the ground in some pleasant location outside the shop, where they work in the summer. Shallow hollows may also be carved in the top of the logs for embosing bowls, forming spoons and

At C is shown the common method of bolding stakes or anvils in a heavy vise. This method has the one advantage of allowing the worker to tip his stakes at various angles to with the work

Iron pape or steel bars of different lengths and diameters may also be bold in the vise and used at anythe or stakes. You will find a colbetton of short lengths of pape and round or equare steel been from the jank yard extremely

A regular stake holder mounted on the beach top is shown at D. Fig. 2. These holders are often sold wills sets of stakes. A piece of then leather slipped between the stake and the holder tends to make the stake hold more firmly and lesseus the noise somewhat.

RETURNING to Fig. 1, you will not a rack for states back of the beach for heavy work and just under the window. If the stakes are to be bong on a flat surface, such as to a closet of on a wooden wall, bravy lurness books. form excellent boiders, two being used for each stake, just as a bacomer is hung on two sails. inother excellent method of holding stakes it to screw a length of old leather or rubber befing, about 1 1 an. wide, to the wall so that loops are furned. Metal washers should be placed under each servir bead.

On the bench for heavy work is a small beach ance. As old flatiron with the handle broken off makes an excellent substitute.

Between the benches for heavy and light work, mounted on the wall, is a pair of large bench scenes for cutting heavy scent metal. The end of the lower handle or leg may be set in a skil us the bench top or bench plate or head in the vine. Above the bench shears is a large pair of hand thears or tinner's snips.

Two wooden mailets also will be seen. One is an ordinary wooden mallet of hardwood, one face being flat and the other dome shape or round for embowing or mising. The other majet, or raising hammer, is square in section and tapered to a blust point at one end. This form a much used in the preliminary of of moving certain types of copper bowls and

It is worth remembering that wooden tools are much used by the professional metalworker, as they leave no marks that may not be easily removed or worked out later on.

Above the mallets are mounted special forms of silversmiths' or copperstaths' hammers for embowed and rased work.

The bench for light work or jewelry making should be built soully although it is of much lighter construction than the other beach. Suitable dimensions were given in an illustration that accompanied the first article in this series, but the size can be varied to suit the shop spuce. The (Centinued on page 133)

How to Lay Out Your Shop

(Continued from page 123)

height from the floor to the beach top is planned to suit the convenience of the worker when seated at the bench-usually between 40 and 31 m.

THE four legs may be made of 2 by 4 m. humber, the other members of the frame heing I by 6 or 1 by 6 in. boards. The top proferably should be of hardwood such as maple or beech, & la. thick. A semicircular piece is usually cut out of the front edge of the beach top, about 5 in. deep and 16 in. long. This aflows the bench pan, described last month, to be mounted, as shown, conveniently over a leather apron or "skin. weich catches sover or goto filings. Sometimes a zine-lined arawer as arranged to slide in and out under the benchpto to catch filings, but many jewelry makers prefer the leather skin. This may be of gen-nine leather or one of the darable, smooth leather adatabates used for chair or automobile quations. Small books are arranged under the bench so that the skin will hang baglike under the bonch pin and yet not interfere with moving the work

On lop of the bench at the left are two maconnections cocks with rubber hose attachments one being connected to a Bussen numer and the other to a month or "combined blowpipe. If you have no got in your slop, you may use an alcohol chang dish lamp instead of a Bussen burner and an arcohol blow torch in place of the gas blowpipe, as I do in

my own shop.

A very small pair of jeweler's suspens shears is living on the front right leg of the beach. It is a good plan to have a small besch vise of the demountable kind, which may be elemped to the front edge of the bench when needed.

The tool rack at the back of the bench is simply a piece of soft wood? In thick, it or S. in, wide and as long as the bench. Slots are made in it for files, and hotes are made for the uther small tools such as acriber divolers, pliers, and tweezers. When the bench is bushed, the top should be oiled and the underpart pointed

The foot power polishing machine, also described last month, is shown on the extreme right. On the wall back of it are hung the various emery wheels, polishing and leafing wheels, and wire scratch brushes. The polishing machine dirubl have a good working oght.

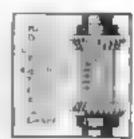
ALTHOUGH not shown, at absolutely necessary, a black-smith's anyil weighing from 75 to 150 lbs., solidly mounted on a beavy wooden block, is useful. Such mavils are best mongree on a beavy section of a tree trunk, the lower part of which is sink solidly in the floor, if the floor is of earth as in most binekanoths sliops If this is not possible, the anvil block should be held to the floor with heavy ongle seems. A skilled metal worker can make almost anything on such an anvil.

If you cannot manage to have a real blackswith a shyd, you may care to lovest a few Jollars in one of the very reasonably procedeast steel farm anvils sold by pardware dealers and mail order bouses. These cast anvas

range from 50 to 100 lbs

If your shop is a small one, you may get olong perfectly well with an improvised flatfrom for an anvil, or a small bench anvil and pipe or steel hars held in the vise. If you really want to do a thing bad'y enough, you will manage it somebow. In metal working or any other craft, the secret is to know just what you want to do and how to do it then you may improvine many ways of doing it and adapt the tools of one trade to another, as you will see further along in this series.

The fourth article in Mr Thatcher's series will appear in a forthcoming lasue.



A finger touch on. Ratchet Shilter gives may one of five adjustments.



Drilling out broken stud bolt in valve cover. This ingenious lankee" Drill does what others can t -and saves time and alber

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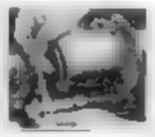
ments shown above, and two speeds, make this ingenious "Yankee" the handlest and fastest breast drill ever de-BIRDEL

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Ratchet Breast Drill No. 1555 (Illustrated), 3-jaw; No. 555, 2-jaw. Hold 1/2 in Drile. Ratchet Hand Drill No. 2545, 3-jaw, No. 545, 2-jaw. Hold 34 in

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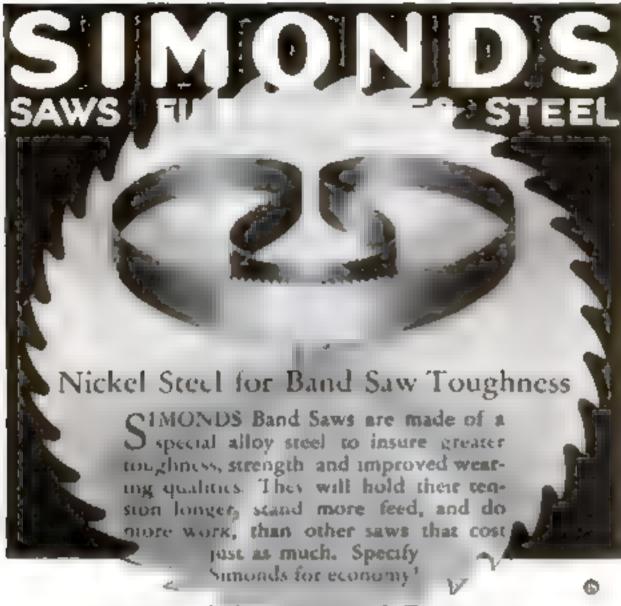
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Addess



If you want financial independence read the story "How a Big Load Was Lifted from Harry Wilson's Mind," on page four of this issue.



The Exterior Setting

(Continued from page 94)

on brackets. The window bus shutters made meless by overhanging rose vines in bloom. In back, at right angles to the wing of the house, the garden is bounded by a clipped hedge with irregular flower planting set against its and just before the bedge encounters the left boundary of the stage, a rose arch and a gate mark the entrance to the garden. Beyond this bedge and gate one gets a view of meadows with trees and a glimpse of distant houses. On the left of the stage and opposite the door into the house is a garrien cent with an awning top in front of this cent are a table and a chair. A cose lattice showing a profusing of blomous is in back of the cent. it is high amough and wate enough to scrown and shut from view the adjoining orchard.

SO MUCH for the written description. Now let us make a rough sketch plan-just a few hastily drawn lines to indicate the general arrangement. The essential elements of the setting are sodicated at A in the lower illustration on page 94; they are shown rearranged at B with the idea of making a better stage parture. For the miles of the composition I have added a tree at the corner of the house.

Next it is desirable to make a rough perspective sketch. If this seems to satisfy the requirements of the script, we had best draw a plan accurately to scale and from this plan work up the stage model.

The making of a model of an exterior set. will call for a little more painstaking attention fluin is needed in the construction of an interror set such as that described is a provious article (December, 1927, Issue). As the various elements of the setting are individual pieces, they will have to be set up reparately instead of in the celf-supporting continuous strip that forms the side of a model of a room interior. In locating the elements, make sure they are placed so that they will inclose the entire scene and, when viewed through the prosecuum arch, leave no gaps and openings us to the back stag. This is an important function of the model. When the melocure has been worked out in the model, the somewright can rest assured that his actual set will be "eye-tight," provided the stage model is accurately enlarged.

In painting an exterior set it is always best to handle the work in a free, decorative way

Even at the best the outdoor setting is a conventum. It can never look as convuicing as an interior, but the audience is always ready lo accept a compromise between nature and art, especially the art of an amateur. The best that the accepewright can hope for is to reggest the out-of-doors. And for this reason be is perfectly justified in giving the set a posterlike simplicity, showing his tree forms in frankly angular outlines, and painting his foliage in mass rather than in detail.

IN THE actual construction of the exterior setting & find that building paper is again a useful economy. On page 94 are shown the backs of two cut-out tree forms. The mine method can be used for the frame of a bedge. For work of this sort it is aften better to double the thickness of the paper, or use an extra beavy building paper

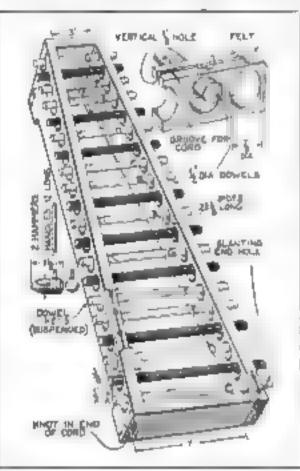
In designing a set the scene wright must keep to mind a plan for lighting it. In the problem which we have been discussing the back drop can be lighted from the line of the bedge; the tree at the corner of the bouse will lend its upper branches for the concealment of these lights; and the bedge steelf will serve to hide a string of floor lights.

The menewright must realise that in an exterior setting the lighting will be his chief aid to the illusion of space. He must plan for it from the start. If it has been properly worked. out his setting will come to life,

Dowel Sticks Serve as Xylophone Keys

THE music of the xylophone in either some or ensemble playing has a piquant quality that makes the time spent in learning to play it well worth while. First it is necessary to obtain an matrament on which to practice, but that is not difficult. Any handy man can make a satisfactory xylophone of the type illustrated. It has a chromatic range from C to G of the octave above inclusive.

Any kind of wood may be used for the box. The keys are made of dowels. Make two sides Agaty 4 in. (tapered to 2 in. at one end) by \$3% in., one end by by \$ by 7 in, and one end 1g by 4 by 3 in. Bevel



The assembled sylophoru and details of the harmers and the method of supporting here

the ends of each of the short pieces aightly to join the aider neatly.

On a line \$8 in from the top edge bore. twenty 30 m. holes 110 m. from conter to center. In doing this place the aides under pressure to a vise or hand screw to prevent splitting. Use a center or a Porstner bit.

Drill a 36-in, hole in the top edge vertically above the center of each large hole and a slanting hole at each end Assemble the box with I 4-m. brads.

Make the keys of \$200, dowels, maple preferred, cut them somewhat longer than required. Tune with a piago or other malgament of permanent pitch, beginning with the lowest note. Make a key sharp by cutting from the end, or fiat by putting a saw cut in it. Stain the sharp keys with black ank or dye but use prother sheliae nor wax. Cut a groove in the upper edge of each side piece to receive the cord,

The heads of the hammers may be made of a 34-m, dowel and the handles of a

4g in dowel.

Stam and finish the box as desired, or not at all, but do not touch the top edges of the sides with ou or war, for the last thing to do is to glue on a piece of felt to cover the cord. -C. A. K.

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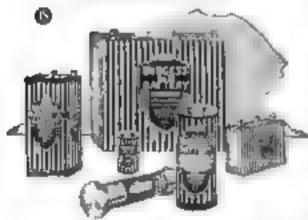
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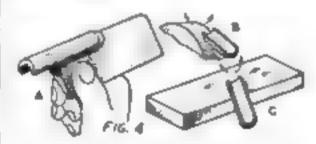
How to Care for Your Tools

(Continued from page 86)

with a try-square, which would be slower. The edge of a chirel should be ground square across as at D. A jack plane or a single-tron plane for rough work should be well rounded as at E, while the edges of a smoothing plane iron of of a spokeshave iron should be shaped about like F. The edge of the sumter plane should be slightly elliption as in 6 In all the eletches the curves are somewhat exaggerated.

Assuming that the edge of the granding wheel as perfectly straught and true, the edge of the entire should be carried squarely across as at H, the wheel always turning toward the edge. Keep the tool moving from right to left. Grand until the cutter is in its correct relation to the edge of the cup aron and a wire edge may be seen the cutire width of the tool.

Grinding is only preparatory to whetling of cilutoning. I we lard into a light lubricating ad on the mistone. Draw the cup fron back to the top end of the proove in the cutter and fasten it, as at J. Grasp the iron and cap in both hands as at K, place it across the stone at



Gouges bewelve us the outside new ground and whetted by turning the hand continually, the were adge in removed with a sky scope

an angle of about 30 degrees and rause or lower it as at L until the exact bevel is attained either by feeling or by seeing the oil that is equeraed out when the cutter is properly placed. Maintain this angle, currying the tool back and forth the entire length of the stone. Guard against the tendency of the tool to "rock," which rounds the edge and destroys the besel. Carrying the sron as at A should largely prevent this, but if it does not the worker will be justified in making circles and figure eights instead of straight motions.

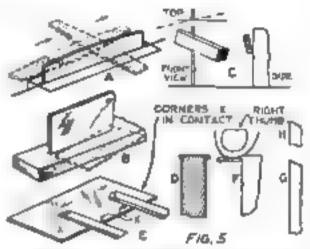
When the beveled note has been whetted from lifteen to twenty-five strokes, the wire edge may be removed by a few strokes with the fare of the rutter lying flot, in prefect con-tort with the stone as at M. Pressure is applied in the direction indicated by the arrows.

The cause of a cloggest place mouth, usually er a budly fitting cap iron as at N Hold the cutter and cap so light may be seen through the faulty joint between them as at O. A very had place may be remedied by bending, but the final fitting should be done with a flat file

Perhaps the top side of the cup edge may have become rounded by long use as at R. in which case it should be bent buck and filed to the mine curve as a new cap area. Be sure that the edge is kept square with the eides. Note that the file at P slants down to make a thin edge. Place the cutter and the cap iron m position as at 8 and with the corner of a church press firmly against the outside of the joint, which will force the particles of steel into perfect contact with the face of the cutter

In sharpening googes the dip stone should he used, but unless used correctly with the hand well away from the cutting edge as at d. Fig. 4, an ugly cut may be received. Outside gauges may be ground on a grinding wheel by lurning the hand as at B and whetted by the tume method as at C.

The actuper prepares a planed surface for the madpaper by removing the manute ridges between plane strokes; it also supplements



A cabinet scraper is sharpened square scross and the curners are then turned over a trife

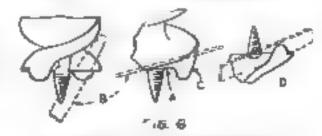
the place is amouthing crow-grained places. The sharpening of a scraper is a knack to be sequired by practice. Place the scraper as a vise and file the edges square person and slightly rounding lengthwise as at A, Fig. 5. Hold the file rither lengt! wise or crosswise, but move it in the direction indicated. What each edge to two sharp, square corners as at 8. Apply a little oil and hold the scraper as at C. The edge of a huranher or the corner of a closel to placed in contact, with the edge of the semper at shown. Point the burnshier or chinel down, keep R square with the edge, and make one light, firm stroke upward. Begin at the bottom and make a heavier stroke. keep the angles shown exactly the same orcept in one respect, push the burnishing tool with the thumb in such a way as to incline it as shown by the dotted line. This will turn the corner or edge of the scraper as in the enlarged. view D. All four corners may be sharpened.

IF THE seruper has been sharpened metest-fully it should out a thin, clean sharing as wide as the worker has strength or skill to produce, but if a powder is scraped, the sharp-ening has been a failure. This may be the case if the edge has been turned over too much or because it has become dull. In either case it may be remedied by laying the scraper flat on the beach and rubbing the edge down as at E. Carry the burnisher at each stroke on the corner marked X. Then repeat the process of turning the edge.

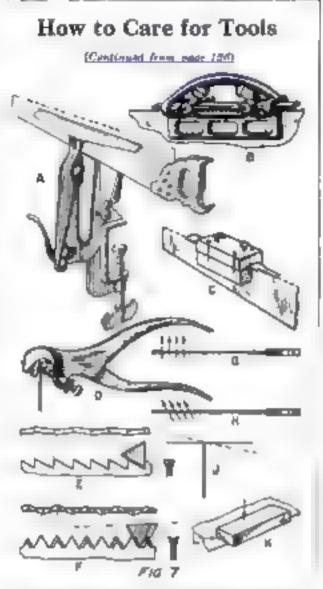
If the edge has been turned too far the dofeet may often be remedied by carrying the burnisher the length of the semper, under the edge and against the thumb as at F, then grving case light stroke as at C

If a scraper is well rounded on an edge or end. and file-sharpened at a bevel as at G, it will arrape paint effectively. If whetted and the edge turned over as at H it will do more satisfactory work upon floor scraping and similar rough work than the square-edge scraper

In sharpening an auger bit, the underside of the cutter (4, Fig. 6, should not be touched, The filing should be done upon the top of the center with a special bit file as at B, thus file has smooth edges at one end so that lip 6 may he filed as shown at D. Do not file the outside of the lips. (Continued on space 137)



An anger bit is sharpened with a special file on top of the cutters and made the lips



How the teeth of a rip may & and a crossout saw (F) are counted set and filed sharp

The overage home worker had better askstep saw floog agress ar can practice apon a saw of no great value. We will assume, however, that our renders with to go the whole dotance. Place the mw in a saw filing vise as at A. Fig. 7. With a flat file held in a jointing. levice take one or two strokes lengt wise to "joint the new, or to make the teeth of uniform length as at B. A jointer may be made of wood as at \(\), though many workmen use the file free-hand. With a saw set \(D \) bend out a ternate teeth for one third of their length from the point they do the same from the other side. At this stage a rip mw should appear as at A and a consent saw as at F

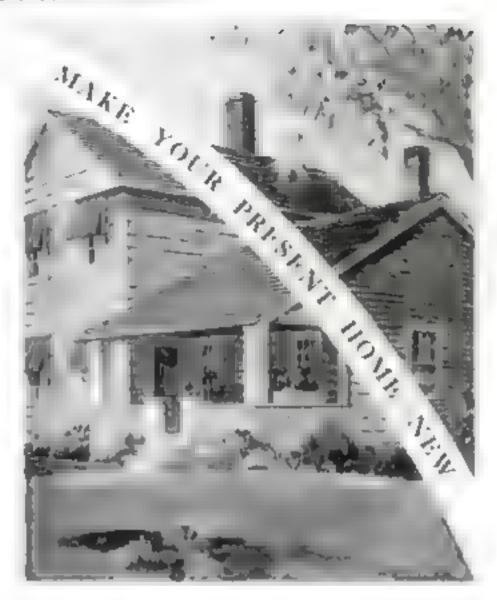
In Bling a rip saw begon at the point and file every tooth scours across, carrying the file at right angles as at to Hoof the life so the ude which is 6 ing the front of the tooth behind it stands vertica as at &. The amateur may find it easier to file a rip saw from each mile, filing the leets that are set away

In filing a crosses I or cutting-off saw the file should be enrited at an angle pointing toward the end of the saw of about 60 Jegrees with the saw blade as at H for a general purpose saw rather less if for soft wood only Many mechanics, however, point the ble toward the bandle.

THE file should be carried as at F to give each tooth "hook," which was large factor of the "sweetness" of the cut

The writer prefers to entry the file level as at J, although many prefer to lower the food a ttle as shown by the dotted line. This appries to cutting-off mass and rip mass if filed from both sides, but in every case the teeth should be of uniform length. This may be attained by watching the gint of hight on the end of the teeth where they were touched by the file when joining them. Remove about half of the glint from each tooth from the first side and the rest. from the other side.

Lay the saw upon a perfectly flat surface and carry a flat file or whetstone from handle to point over the teeth to remove the hurheep the pressure as at A so the stone will bear a little harder at the edge marked L.



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Simplest Flying Model

(Continued from page 117)

is fitted into a notch at the rear of the fundage and glued and bound min place. The other two rides of the tail frame are made of wik thread. Cut a very slight slit across the under face of the fuselage 5 m. from the tail end. Split one end of the tail spar and fasten the thread in it, then lead the thread into the notch in the fuscinge and fasten it to the other end of the spar Draw the thread light chough. to spring the spar forward slightly, this keeps the tail surface taut.

Cover the underside of the tail with bamboo. paper. Spread give along the spar and thread. ay on the paper and press it down to assure sta stacking. It is not necessary to turn the margin of the paper over the thread. Just trum off the margin, leaving only λ_n in. of it beyond the thread. Trim off the margin along the spar with a many blade. Gave the tail one cost of bamboo varsush.

HE rudder outline in made of 🍆 by I by by 18 an hambon. Forey one end into a hole drilled into the end grain of the fuselage and the other end into a hole drilled vertically through the fueringe % in. from the tail and. The brace is % by 14 by 31/2 in. bamboo. Force it into place, cover both sides of the rudder with hambon paper and give each side one cost of hambon varsush. True off the margar with a razor blade

The main wing is of the single-surface type. The space are \$6 by \$6 by \$6 in, white pose. The tear spac is bent at the center until the emis are I in higher than the center; the front spar should be first until the ends are 1% in. higher than the center.

Whole pear is beat in the same manner as bamboo, but should first be soaked with water at the point where the bend is to occur

There are seven barebon ribs 3a by 36 by 4 in. They are bent in a curve, the highest part of which is located one third the rib length from the leading edge. The center rib should be searly flat, and the others bent up about \$4 in. The ribs are spaced \$53 in apart. Put a drop of glue on the spar and bind such rib in place with four wraps of eilk thread each way

The tipe are 14 by 14 by 2 in hambon and extend 5 in beyond the ends of the spars. They are bound to the laner edges of the spars with all thread and give.

after the wing in assembled, true it up and allow it to dry thoroughly. Cover the frame on top with hamboe paper and apply two reats of baseboo variable.

THE wing saddles are made of 1/2 m. THE wing morney are Start bending at the center of the wire, making two bends straight down 1/4 in apart. Go down 1/4 in and bend the wire up at such an angle that it will meet the wing spar by in from the center line. Here an offset or notch is made to fit the spar. The were to then led across 4 m. and another spar offset is made. Bend the other end exactly the same way. Make two of these and map one into the front spar and the other onto the rear spar. These suidles must be accurately made, as they govern the wing adjustment.

The propeller is made from a block of roft white pine 1/2 by 13/4 by 8 m. Draw the blade outline and cut the block in form a propeller blank. Drill a bis-m, hole exactly in the tenter. Carve the back face of the propeller concave and the front face convex. The contour of the blade's cross section should be such that it resembles a wing curve. Sandpaper the propeller to a smooth finish and balance carefully so it will not vibente when turming.

The propeller shaft is made of bicycle spoke 21) in long. Turn a rubber book at one end with a pair of phera. Lead the shaft through the bearing and put on two washers of copper with 1/4-in holes. Force the propeller onto the shaft and then (Certifornal, on years 1987)



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"Spirit of St. Louis"

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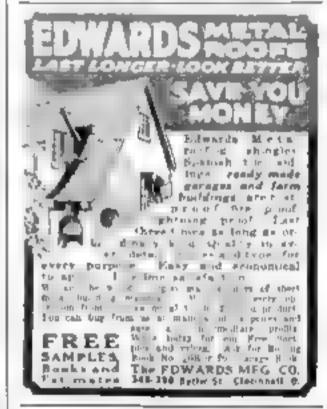
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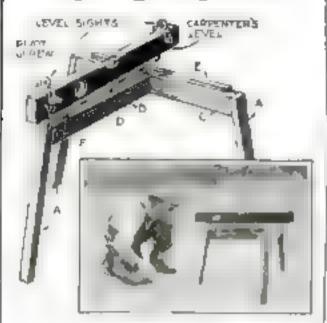
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Carpenter's Level Used for Sighting Long Lines



Row the triped stand is made and used for running foundation lines and similar work

IN SETTING foundation corners for small buildings and in grading, ditching and the like, I have found useful a simple tripod made as shown. It supports a carpenter's level equipped with sights of the type that can be obtained in the larger hardware stores.

To make the tripod the following parts: are required; 3 legs A, 1 by 2 by 24 in.; I backbone H, 2 by 4 by 24 in.; I crosspiece C, # by 4 by 24 in.; I level rest D, 1 by 2 by 30 in., 1 filler piece E, 1 by 1 by 24 in., and 1 filter piece F, 1 by 2 by 2 in.-Gronon W. Royke.

IN MAKING small parts for models I have found useful old safety rasor blades of the type having a stiff back. These are broken, chipped, ground and filed into various shapes to suit the need of the moment, the back being retuned as a handle.-C. BALDWIN WHITE.

Simplest Flying Model

(Continued from page 188)

turn a tight loop on the end and force this loop into the wood at the propelier hub.

tave the fusciage and and propeller two coats of bamboo varnish.

Loop on six strands of 1/2 by 1/2 m. flat para rubber. Lend the rubber from the peopelier thaft through the "cans, over the top of the wing, to the rear book. One may lubricate the propeller shalt bearing with a drop of oil or

To fly the model, prem the wing suddles onto the furringe and loop a rubber band over the wing and under the fuselage. The leading edge of the wing will go about 11 to from the propeller. Glide the model. If it glides beavily to the ground, move the wing forward. If it shoots up sharply and stalls, move the wing to the rear. Adjust the wing until the model makes an only glide.

WIND the rubber clockwise until there is a row of knots its full length. Start the model above your beast in level flight with the wind. The model may be turned to the left or right by forcing a sught bend in the rudder. After the model is correctly adjusted it may be wound its full number of turns, about

This model will make beautiful long flights consistently and go up to a high altitude.

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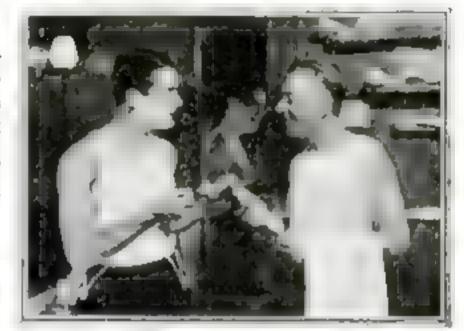
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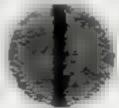
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Plumbing Hints for Home Owners

Water Heating Coils

By HUCH WILLIAMS

BY FLUSHING out the water-heating cod in the fire pot of your house heating (genuce or boiler and by keeping a daplicate coil always on band so that it can be speedily installed in an emergenev you can forestall trouble with this

part of your plambing system.

There are several reasons why every householder should gave careful consideration to this subject. For one thing, no coal will give satisfactory results during both and and extremely cold weather. Its presence in the fire pol creates a dead spot directly below so that the cool at that apot is not entirely hurned. Then too, cods will break, usually it seems, on Sunday a holiday or at night, when it is almost unpossible to get a plumber

Code are usade in various shapes and in both seen and brass. The writer recom-

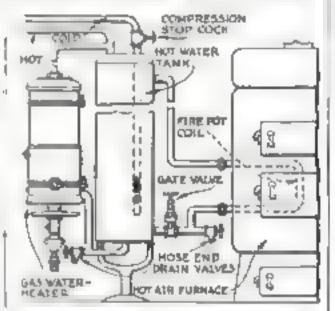


Diagram alwaying installation recommended by Mr W mame. The vent on the gag water-hoster must be connected to a chimney

mends one piece bent pipe coils, which are the elseapest, interfere with the fire the least, and offer a smooth interior passage for the water. Beaus pipes and fittings are, of course, to be preferred.

It is better to install a small coil that will deliver bot water in the coldest weather only the the gas water-heater during the fall and spring or on mild days. during the winter. Furthermore, keep the coal away from the center of the fire,

Install a control vaive, preferably a wheel handled compression stop cock, on the cold water supply to the hot water tank. Then when the coil does break, the water can be turned off at this point.

Install a gate valve in the return pipe between the coil and the tank, with a wheel handled hose-end drain valve in the line on the coil side of the gate valve. Lee this frequently to flush out the lime. scale and sediment in the coil by closing the gate valve and opening the drain valve. A good idea is to attach a hose to this drain valve and wet the askes in the ash pit before removing them. Be sure to close the gate valve to get best results (Continued on sage 131) in flushing the

Walnut Shell Made into "Comicull" Elephant

By F. CLARKE HUGHES

FEW odd buts A of material, a few minutes of time, and a little patience are all that you need to make the little elephant shown as this month's "consent,"

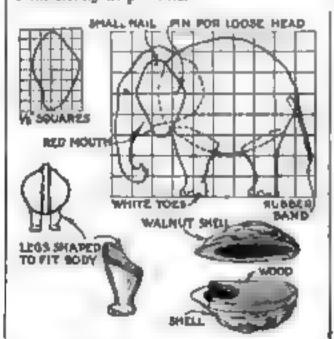


A movetty for use so a disper favor or toy

First take large walnut shell and a thin piece of wood that is a little larger than the walnut so that it may be marked and shaped to go between the two halves of the shell. Cut the wood to the shape shown and glue the two sides of the shell to it. Make the head of thin wood and cut out each leg separately to fit against the sides of the shell.

The ears may be made of bits of leather and gloed or nasled to the head. Paint as

realistically as possible.



How the elephant is made. The larger squares represent 14 in., the smaller over, 14 in.

Water Heating Coils

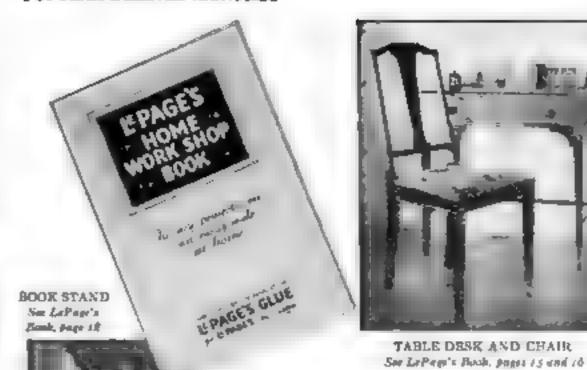
CONTRACTOR OF THE PARTY OF THE

call, and then be careful to open the gate. valve again to insure circulation from the coil to the tank. The flushing will prolong the life of the coil.

Under no circumstances should valves be installed on both coil connections, because the closing of these valves would create a steam chamber that would burst when the fire became intense and probably cause serious damage,

Get a duplicate coil and tie it to the beam right over the beating boiler. Then. when one coil breaks, the plumber can install the duplicate, take the old one back to the shop, and at his convenience make another one, which can be attached to the beam ready for the next emergency.

In making small parts for models I have found taseful old safety rasor blades of the type having a stiff back. These are broken, chipped, ground and filed into various shapes to sust the need of the moment, the back being retained as a handle.—C. Baldwin White.



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The directions for each are given in three parts, namely complete dimension drawing of all the parts, sample printed directions for making given step by step from start to finish, and a photograph of the feashed article. Euggestions for suitable woods to use and directions for the best ways to finish each are also given.

The photographs shown on this page show the pleasing results you can obtain for a few evenings' fun (not really work) during the winter. And in addition to the 4 articles shown here, the book includes the following 16 articles: Occasional Table, Spanish Ship Model, Folding Sewing Screen, Pernery Stand, Tilt Top Table, Piano Beach, Costumer, Priscilla Sewing Buz, Cedar Chest, Card or Console Table, Turned Beach, Dressing Glass, End Table with Book Trough, Poot Stool, Back Rest and Hanging Book Shelves. Where else could you get complete directions for making all these things for only



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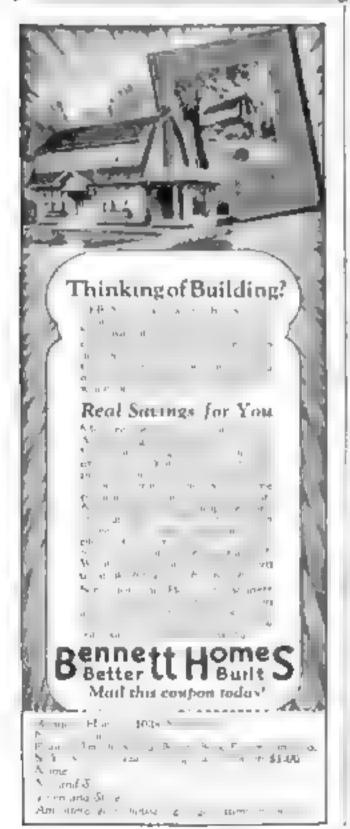
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A Guide in Choosing a Radio Set

(Continued from page 70)

as well be operated on direct current from a storage battery, although they wouldn't be desirable for such use because of the heavy current required at comparatively low voltage

Then there are the heater type tubes, such as the 227 type, where the blament is used to heat a cathode or small hodow cylinder, and the latter supplies the stream of electrons to operate the tube. These tubes operate on raw alternating current stepped down to two and one half volus. They, too, could be operated with just as good results on direct current from a storage buttery.

Another type of full electric set uses ordinary 201A tubes or 199 type tubes. The built in B-chiminator in such sets is made large enough so that in addition to the B and C requirements of the receiver it will supply the necessary direct current for the A or blament circuit. The blaments of the tubes are connected in acrics.

The third system is to take a standard type of battery set and hund into it an A-chiminator as well as a B-climinator. Sets of this type are just as fully "electrie" as any others, provided they require no attention beyond the occasional replacing of a tube. However, thu method calls for more apparatus and the additional advantage may not compensate for the extra expense

Now as to the relative advantages of these various types of electric sets, it all depends on whether or not you buy high grade apparatus. Theoretically each system is capable of equally good results and the only question is, therefore, whether these results are obtained in the partieular set you are thinking of buying. And the Popular Science Institute of Standards can help you decide that point

Radio apparatus, including electric sets, eliminators. A C tubes and all the most modern stems are tested and their money value determined. Approval by the Institute means that the apparel is approved is worth the money. If, for instance, a particular electric set costing \$150 appears on the approved last it means that the receiver is carefully constructed according to approved methods of reliable parts and will give good service. Naturally, it will not be as good as a \$300 outfit. If it were, then the \$300 outfit would not be worth what it cost and could not appear on the list

A Wireless Electric Light

AN EXTRAORDINARY new type of electric bulb without wires, developed by Dr. Phillips Thomas, research engineer of the Westinghouse Electric and Manufacturing Company, glows when held within range of a powerful electromagnet. and continues to glow for ten minutes after the power is shut off! Though you could turn it off, undress, and jump into bed by its light, it has no such immediate utilitarian purpose. It was developed by Dr Thomas in the course of experiments be a conducting on the transmission of power by radio

What We Owe to Newton

(Continued from page 55)

A trifling difference of less than three feet in the figures would not bother some theorists, but to Newton it was a great discrepancy, and caused him to shandon the research for the time.

Four years later Newton went back to the problem and found that he was right the first time and would be forever—if Earstein permits—right foravitation was established and the universe was sale. The cause of the early discrepancy in figures was an imperfect measure of the earth which gave a degree of latitude as being artly nules. The corrected distance for a degree of latitude was 60.1 miles. The new calculation on the pull of earth upon her lunar friend worked out very closely and the law of the inverse square became a permited back as in the physics of gravity. It is in fact a self-evident truth.

THE heat illustration of the inverse square on in light time square foot of right at twice the distance from the source, or two feet, spreads to cover four square feet of surface. If the distance is again squared to four feet, the original square feet of light spreads to cover sixteen square feet. The original amount of light remains the same, and spreading, it reduces or that it in the proportions given in the last case a square foot has one sixteenth the intensity of the original amount of light.

Gravitation works on the same obvious principle, though invisibly. It is a magnetic form that spreads from the center of a sphere equally in all directions, increasing or destinabiling according to the square of the distance from the central source. It is mutual between spheres. All matter particles of it, him or mass is a ruling factor.

Everything was great to Newton's mathematical call. Whise plumbing the depths of celestial space he analyzed the laws of chaper that govern card playing for the benefit of his friend Pepys, man about town and author of

the woll-known "Dury."

In Newton's time scientists had queer ideas on light and especially as to the origin of color. For example, red was supposed to be a condensed form of ight, while blue was composed of black and white particles, as illustrated by the ocean mixture of black water and white self. Instead of guessing in this way, Newton made a hole in a window strater, let a ray of sunlight pass through the hole and then through a glass prism. Thus the white light was separated tota the coint elements of the spectrum from red to violet. The young experimenter measured all angles and distances, shifted his prism in every way, added more prisms and combed out by itself each hand of spectrum color.

HE THEN announced to the world what is now taught to every school child that white light is composed of rays of different wave lengths and that these rays, if separated, affect the eye as color—reo for the short lengths and violet for the long lengths. Objects that we see as colored only seem so because they reflect a particular kind of ray and abourb the

rest of the light.

Having found that the rays of white light do not focus together through a lens, Newton decided that the only efficient telescope must be on the reflecting or nurser principle. He built one on this principle that was a mere six inches in length, and yet it could magnify forty times, or as much as any refractor telescope a dozen times as long. With his tiny instrument the young man who was soon to become the master successor of the universe "saw". Jupilet distinctly round, with his four satellites, and also the horns or 'moonlike phase of Venus.



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What We Owe to Newton

(Continued from page 135)

As usual, rejentific rivals tried to shake Newton loose from his optical discoveries. Had be not made a motake with his prisms and angles? Newton was the hulldog breed. He had proved, he knew, and he never let go of any truth once in his grasp. The rivals growled and in due time backed away

Like other genuies, Newton had his blindspots. The first was alchemy and the second was a sort of fantastic theology. He wrote to a friend about to travel through Europe, asking him to "look into the very profitable science

of turning base metals into gold.

To understand such apparently childish creductly it is well to recall that alchemy and chemistry were twins in Newton a day knowledge was in a pioneer state. Furthermore, his fundness for alchemy did not after by a hair's breadth the rigor of his mathematical research in pure and applied science. Again, the alchemist has almost regulied respectabirdy today drammutation of elements is now accepted theory solar accentists declars they have turned mercury into gold

WEMAY compare Newton, the alchemist, with Sir Obver Lodge. the modern spirited. Each is sound in science; each may

be baif right in his hobby

Honors came to Newton steadily, from a professorolop of mathematics at twenty-eight, to his becoming member of Parliament a knight at the hands of the queen, president of the Royal Society and master of the royal mint. He took the latter job very seriously. devising improvements in comage and ways of preventing counterfeiting. The custodian of are currency was annoyed when the world light pestering than with questions on gravitatoof. He wented to thank that, after all, the eg all must encapretty appearant and gravitathe way a topic to consider after bauness

Newton never matried. It is and that he kept a lender place in an heart for the gri-payment. Man Stores, for whom he hult doll furniture, and he provided for jer tunneally its her latter years affirmigh she was frice businers.

Toward the end of his long life of eighty-five years, Sir Isaac Newton said of himself with revealing and appealing modesty:

If I saw further, 'tway because I stood on

gunt shoulders.

HE MADE another statement yet greater that has deserved a because a classic, a thought of sublime humility and wisdom that man will never surpose and that may nutvalue all his concrete achievements:

"I do not know what I may appear to the world but to myself I seem to have been only like a boy playing on the seashore, and livertme myself in now and then finding a unnother proble or a prettier shell than ordenary, while the great ocean of truth lay ad undecovered before me."

Trees Gage Wind Velocity

YOU can judge how fast the wind is blow-ing by trees leaves and branches, says a French observer, who gives this table. No appreciable wind, leaves still, up to two

miles an hour. Light breeze barely noticeable. leaves feebly agitated, five miles. Moderate breeze, branches stirring slightly, ten miles. Branches bend a little, lifteen miles. Branches ruclong and swinging, poplars bending, twenty

heaves torn from the trees, twenty-five miles. Tempest, light branches broken, thurtyfive miles. Violent tempest, strong branches broken, fifty-five miles. Harricane or tornado, damaging bisse roofs, in the neighborhood of eighty asiles an hour



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If you want financial independence read the story "How a Big Load Was Lifted from Harry Wilson's Mind" on page four of this issue.





Where Did You Catch Cold?

I am mund from page 28

to intense cold to see just what effects it would have. In the laboratory their necks were exposed to a grut of sey air—one of those draftwe have been taught to fear. This artificial north wind was allowed to blow for some time, after which do victims were examined

The examination revealed, for one thing, a set of sore throats. Furthermore, there was an apparent increase in the number of germs in-

habitoug the throats.

The experimenters enachided that one factor in the beneficial effects of cold bathing and outdoor living may be the training of the blood vessels to react to chilling by increasing the blood supply and so destroying getme an example of the tendency of nature to cure its

When we hear of a cold wave, we think of snow and librarids, yet the term liberally dearribes the way colds affect the country. They da not confine themselves to one spot of even to one regain. They cover the country

SEVERAL investigations have been made to determine the extent of these epidemics and the time of their occurrence. One survey, recently made by the Federal Government, showed that, regardless of great differences in temperature, colds increased simultaneously al over the country, and decreased simul In necessary.

The time of greatest prevalence was found. to be January and February. The second worst time of the year was October, with the commy of cold weather; the third, sarly in Some evidence fends to show that decent. neither the incidence not the severity of the disease has direct relation to climate, but that both are due rather to radical changes in dress and to other changing conditions at our mode. of hving which go with variations in the west Largery

The Metropolitan Life Insurance Company has figured the effects of cold down almost to a degree of temperature. I sing 6700 employees at its headquarters in New York as a basis of investigation, the company found that a drop of ten degrees to the weekly mean tempersent are mercure of eighteen colds. in the group. Suove, race, and bound by however apparently find only a gld influence

There are many kinds of treatments for colds. They range from encounts baking side to procesuation, a in from red dange, to et lorane, the dearly gas used to the World War.

Most doctors advoc taking a sasative and sweating the error out of the system by keepang warm and padictously many but srinks.

The moculation treatment has been approved and disapproved. By means of two vaccines, one prepared from the bacteria in the threat and the other from animals, this front peop is intended to make the patient immune. Remarkable results, however, have been outed in some metapoes. In other cases, the treatment has had no perceptible effect.

Chlorine gas as a remedy in in pretty much the same status

NCFREADATY regarding the true cause U of couls has streamfuled setentific research to a point where important discoveries are expected soon. Those engaged in the investigatson include the Convernment, the Chemical Foundation, and the American Drug Manufacturers' Association. The American Telephone and Telegraph Company has undertaken. an extensive survey of the disease among its emptoyees. At numerous medical colleges experimental work has been long going on

These activities indicate the tenseity with which seigned is clinging to the train of one of man's worst enemies—an enemy that is invisible, and one whose identity is as yet but

dumly discerned.



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A Carpenter's Method for Spacing Work Quickly

ALMOST daily in my carpentry work spaces into equal parts that is simple, speedy and foolproof. It is so rapid that I can say what the divisions will measure as quickly as I could measure the length that is to be divided up. This often surprises those who are looking on.

As an example, suppose a partition is to be put up across the end of a room to make a closet and is to be divided into three parts by stude (uprights), as shown below. We do not know just what the length of the partition will be, because we have not yet measured the width of

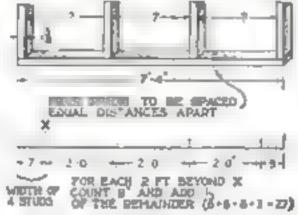


Diagram Bustrating a quick method for dividing wells into equal opeces, as for people

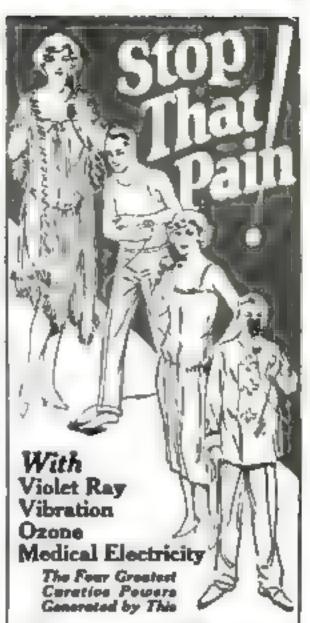
the room, but we do know that four stude will be necessary—always one more than the spaces (except in circular work),

First, we measure on the floor where the partition is to be placed a distance from the wall equal to the combined width of four study, in this case four times 134 in., or 7 in. Here a mark (X) is made. Next we lay our 2-ft. rule down, starting at this point, and my to ourselves not 24 in but 8 in., or one third of 24, as we are to have three spaces. We lay the rule down again, measuring 2 ft. more but adding mentally 8 in. We do this again asid add 6 in. more. In other words, we say 24 in although our rule has actually covered 6 ft.

We find a space of 9 in. left over This we divide by three and adding 5 in, to 24 get 27 as the distance at which to set the stude apart in order to divide the space into three equal parts. A study of the diagram will make this clear,

If four spaces had been wanted we should have used the same method but added 6 in, each time we set down the 2-ft. rule. For six spaces, we should have counted 4 m. for each move. For five spaces, it would have been necessary to take 20 m, on the rule each time instead of 24, and to count one fifth of that, or 4 in. H. L. Derby

WEAK compression springs can be made longer and often restored to usefulness by holding them on an anvil or some other solid surface and striking between the turns with a cross-peen hammer. The blows should be quick and rather hard, Pass along the spring to keep the tension even and turn it slowly as you work. H the spring is bowed, the same process may be applied to the concave aide to straighten it. Gas engine valve springs can be put into excellent condition in this way.—Sherwood J. Gee.



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When You Buy a Car-

hand," Gus went on, "the our you're fixing to buy. Ben, is not so good. It wu't much as a hill. climber. It's sluggesh on the peck-up. It needs overhauling perhaps a little more often than other cars in the same price class. And it needs quite a lot of servicing. Judged strictly on merits as a car, I'd my it was inferior to a number of others I could more.

"Humph!" muttered Ben. "Then I suppose: you'll say I ought to follow Hank and vice, ch?"

Not at all, said tous. "The quality of a cur-any car is only a part of the storyand sometimes a mighty small part at that.

As a matter of fact you fellows could have aved yourselves the trip down here. You re both right! Each of you has picked out the carthat I would have recommended.

"I don't see how that can be," argued Hank.
"You we practically told lies he's picked a lesson and yet you tell him to buy it. What's The true idea?

"Well," and Gos, "the point it, I know you two birds. You're a bug on anchinery, Hank. You'd take care of a car so well there wouldn't by a chance for any real trouble, and if you do have a breakdown you'll fix it yourself. Chances are after you've once bought your our you'll never go near the dealer again.

NOW, lies, you're a lawyer. You den't mechanism. You don't know what goes on under the bood of a car and you probably don't. care. All you want in a good-looking bus that will stay on the job and get you from place to

place without worry.
"But why shouldn't I take Hank's advice?"

questioned Bea.

"Two good reasons, Ben," Gus replied. "The dealer who handles the car Hank favors s, as I happen to know, a slick article. He'd stick you for a wad of money every time you poked your now in his doub looking for a little service. That doesn't make the slightest difference to Hank, because he II never have occusion to go near him. The second reason is that the dealer who handles the our you've picked out would appear go out of business than take advantage of anybody. Maybe his ear isn't quote so good, but he il keep it on the job for you and that a what counts!

When you're buying a car," Gus summed up, "don't let a high trade-in offer stampede you agto buying a car you really don't want. lick your our solely on the bank of mechanical merit if you expect to do all the work on it yourself, but if you expect to let somebody cise do the work for you, choose the car that is represented by a dealer who is able and willing to give you knoest service."

New Gains in War on Disease

Figures, not speculation, are the basis for recent statements that progress of the war agaztet disease is more hopeful than ever

John K. Gore, Vice President and Actuary of the Prodeutal Insurance Company, finds that in the last quarter century science has seved 635,000 lives each year, and has prolonged life in thaty-two countries.

The Surgeon General of the United States, Dr. Hugh 5. Cumming, recently reported that during the year ended June 30, 1927, there was a general decrease in the number of communscable diseases, and that America was free from epidenucs and plagues. Research work for control of energy gotter, influence, leprovy und

The fight against cancer was focused in a nation-wate company of education, with the collegeration of physicians and hospitals. Doctors my that this dread disease, which stands third as a cause of death in America, can be conquered if caught in its early stages.



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Percent and rains out up, his is no paying arranged in many type you had by Company of the Dept. 1972, 19-25 44th first. Long intend City, Sure Tool.

A definite program for getting ahead financially will be found on page four of this issue.

Is Lost Explorer Now Jungle God?

(Continued from page 17)

the lower reaches of the Xingu in a dagget, has little party might at any moment have been wiped out by a storm of populated arrows from the hows of ambushed Campos ne Gavanes.

But pulled off to the eastward they would have run into no such serious perd. They should have emerged musty months since eather on the Atlantic Coast at Bahm or at the mouth of the Amazon after a comparatavely easy trip down the Amguaya

Then what mishop has delayed them!

Let a reconstruct their subsequent adventures. Chopping their way papifully a few miles a day, through vine-targied jurglewhere even at pone the light to dim, they encounter on dangerous animals. Even a jaguar will not attack naless wounded and cornered.

BANDs of chartering monkeys pursue them overbrod gorgeous burks and butterfies flicker through the trees. Wild life all around there, but none of it is dangerous.

Hunger is peedless, there is game on every hand. Malaria is not fatal. A novice might get lost tol. hawcett is equipped with compass and mapping paraphernals and familiar with every frick of " jungle navigation.

So there remain only the Indians to be reckoped with.

But these wild children of the jungle are less dangerous than the semicivalues tribes whose haupta Col. Fawertt has long since passed. As the Fawortt party proceeds naked wormers slink through the ferns to watch with children curiosity these strange creatures. But the party plads methodically ahead and makes no offensive actions, and the Indians leave them alone. Faweett is too wite in Indian psychology even to unstring his comern. A comern pointed at them will frighten them into beligerency But if a monkey is shot for lunch, the sound sentters the trailing Indians in abject terror-

But as Pawcett penetrates further into the jungles north of the River of Death his transport problem becomes mevitably more difficult His mules are gradually perishing from bunger or disease. He awakes one morning to find that vampure buts have rucked so much blood from one ansmal that it must be killed. Later a pale of pack mades becomes hopelessly totred in a swamp. Forting a swift river, another is carried away and drowned. Descending a steep mud hank, one falls and breaks a leg. And when the pack train has dwindled to two or three. Fawcett a party, unable to continue, stops at an Indian village for native belpers.

AND here arises the disastrous mutake in he left that when he came to dealings with the Indians he would play upon their superstitions to persuade them that he and his companions were supernatural creatures endowed with magic power While among them he has used his rifle, surveying instruments, matches, compass and dashinghts to arouse their fascountry superstitions.

And then one day he and his componions awake to their wigwam to find that all their supplies have been stolen. They are helpless. Their Indian hosts have become so impressed by the magic power of these white gods that they have taken sleps to keep them permanently in the village. Thus the whole tribe will stare in the marie, become all powerful in war and the chase, and be freed from the terrors of Nature, like thunder and lightning

It is the historic hobby of these Britishan Indians to make such prisoners. From the days of the early explorers, Jose Rassalho and Drogo Alvares, down to the year 1927, the instances of whites in cuptivity throughout this country are frequent. Recent cases are ested by the Bearilian (Continued on page 140)



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ls Lost Explorer Now Jungle God?

(Continued from page 159)

rthnologist, E. Roquette-Pinto. Last summer I heard of cases near Jurgens. The Indiana' fondness for strange human beings, whether white or segro, resembles a child's affection for a toy. They ching to them and make tribal divinities of them.

Col. Pawcett sits presumably today in the door of a crude wigstam. Other wigstam are dotted about. Indian women crouch over the first, toasting tapirs and monkeys; the menare off hunting, or practicing archery with hornets' musts for targets. The Colonel and veillance of a band of gurla.

And what can the white men do? Try a violent escape? They can no more get out of that witherness, once the Indiana' animostly is aroused, than a cornered mouse can escape a cut. Col. Fawcett, knowing this all too well. can only wait patiently, hope for rescue, and continue to play his role of masor divinity.

He, with Jack Pawcett and Raleigh Rummell, have become a pagen tribal trinity, and as such they are sale, well eased for, worshipped with weird rites and fed on outlandesh dainties like iguana eggs and reasted ants and caterpulars. At night they watch the ceremonths denoted in which naked warriers, pointed red and black and wearing gausty feather headdresses, shuffle about the fires with a monotonous guttural chant.

I could describe their daily life in detail, for I was for a short time a minutar raptiveguest among the Carajan, on the Island of Bananal. The Amguaya River flowed by the village, and offered escape to the Amazon. In the wilderson north of the River of Douth, tol. Fawortt has no such apportunity-

BTT now let's look ahead a few months.

One morning as Col. Fawcett wanders about the village, he notices suddenly an alert restimeness among the Indiana. Their wonderfully remutave care have caught a distant drone, faint but increasing, which in another moment he himself hears. The naked brown bidge become right, the black eyes probe apprehensively the jungle forage. The drone becomes an appalling roat. The Indiana purceive a monstroom white hird awooping low over the tree tops and singing a terrible song-

instantly, with cries of abject horror, the entire population of the village fices into the fastnesses of the jungle. Fawcett and his companions, left unguarded, rush to a clearing, in a mild demonstration to catch the eye of the careling arman. Or if there is no cleaning, they raise smoke samals through the foliage. Commander Dyott a surplane has found them.

This is the only solution that I see to the mystery of Col. Fawcett's desappearance. It has been part of Commander Dyott's project from the start to use an airplane to his relief expedition. An overland party cannot pick up the trans even Fawertt a map rates will have been obliterated.

The acouting arrown can detect the location of Indian villages and they are not as ous- by definite ages. The warwards will be obscured by fottage, but three will be a near-by clearing, a few dugout export and the smoke of fires enough through the foliage.

Spotting his villages, the airman will circle over them as I have suggested, and from one or another at last he will receive the signs that reveal Col. Fawcett v presence The ground party, notified by radio or, if that is wanting, by the return of the purie, will peak through to the varage. And when it reaches the scene of Cal. Fawertt's improvement, the plane will arrive again, sending the myages once more far into the jungle. And I can imagine Dyutt. striding up and paraphrasing Stanley's words. "Col. Fawcett, I presume?

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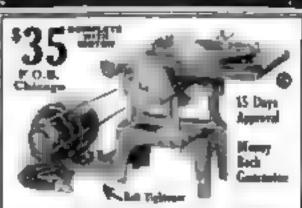
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Triumphs of Radio's "Hams"

(Continued from page 40)

Thought? See you later best regards "Would hongs annoyed the early operators. On the authority of the League, the name woulf hong is a typically garbled, unintelligible phrase from an inexpert dot and dash operator, and its real significance is the local interference that has all but disappeared with the abolition, except for emergency, of the old-fashioned, sputtering spark set. "Hazas conceived the would hong as a mythical, airlurking beast whose statubles growls disrupted. fransmission.

At last, in 1002, an American amateur, 1BCG, of Greenwich, Conn., transmitted the first amateur trans-Atlantic message, and ten-other amateurs were also beard by eight British "hams"—all this with extremely low power-less than a kilowatt-and with grasshopper-med antenua.

For the first time in history, on the avenuagof November 17, 1944, two amateurs on opposate sules of the Atlantic were talking with each other. Station IMO, in West Hartford, Conn., heard a radio flash from Leon Delay at station BAB, in Nice, France. He replied and for two hours they conversed. Now the international conteurs use conventional aguals, such as "Office, meaning," I ain receiving well," while they brush up on their foreign languages.

IN 1923 Hiram Percy Maxim, noted inventor and President of the American Baday Relay League, went to France and suggested formation of the International Anuateur Radio Union, which elected him its president. In November of that year the first international amateur call list was published.

Now now tests commenced. The amsteurs had been relegated to what commercial companies considered waves of no value, such as those below two hundred meters. But these low waves in the amateurs' skillful hands proved the most efficient of all for long metance. The hains soon were able to me as short wave lengths as twenty to forty meters to

tack around the world! This was the stage setting when the Inter-national Radio Telegraphic Conference met recently in Washington, D. C., to settle all the new problems, and, incidentally, to decide the fale of amateurs. America knew the value of amateur notio, and the United States was the amateurs' friend. | Fecretary of Commerce Hoover commended them. Canada, Australia, and South Africa, where amateurs were powerful, were friendly. But broadcasting stations of other countries were greedy for the very waves the amateurs had developed.

Title Conference's recent decision is an amounting, unprecedented endorsement of the amateur. Now the radio amateur has interrestance status and recognition. Radio "lama" the world over have the exclusive one of two of the most useful low wave bands, strips at their regular wave lengths of twenty and forty meters -which are forbides to commercial and even to Government stational. Besides receiving the right to share two wide bands used largely for radio phones instead of dot-and-dash transmitters, amateurs are given, too, the free use of all waves below thateen meters.

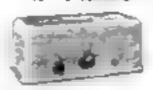
In this dark, unexplored region of radio they hope to make new advances as striking as those of the past. Already their international tests are under way with waves as short as five meters!

Through a countrywide investigation POPULAR SCIENCE MONTHLY is now able to present first-hand information upon the real status of amateur aviation. Read next month the facts disclosed by the first authoritative survey of the sirplane's practical use as any man's business or pleasure vehicle.

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art. Enables operator to get the best possible results with any tube.

This proneer in filament centrel of radio tubes is still mighty popular. Provides noncieu, step-



less filament control for all tubes. Try a Beadleystat on your next set.



He Rebuilt His House and Saved \$6000

(Continued from room 74)

two and a quarter inches wide, the usual random lengths. Of rourse I put on the oak at right angles to the old boards. As to thickness, I med ween-eighth-cach downstage and light their upstruck. The thunner staff upstairs was not to save money but to avoid too. much pounding lest it damage the plaster rethings below. Oak is tough and takes some bammering.

I guess you used the regular flooring and ? "No. I get square-cut galvanted made eightpeany for downstages and fourpeany for up. Somete hads are more difficult to bandle and to arous splitting the wood, but they hold better. When the floors were laid, I scraped I them by hand, put on two coats of shellar and finished with way. Incidentally I saved about two renta a square foot on my ould by buying it. to winter when the lumber trade is sla it and prices are lower. This saving paul for the toaleral in one mom.

HOW about that old plaster you were

"Oh, that him plaster is more solid than you'd those. It hangs ingether because of the bair it contains and it is about twee as thick as a good drul of modern plaster. It mus to an meh and a half. It will stay for another generabion or two

The roofing is asphalt shingle over two-ply s-phalt roll rooting with sheathing boards

I took out the old warm air fursace and put in a steam losler with a single pipe return aystem. It serves both families. A water heatmy device is connected with it.

" We have two electric soltages, with and 140 The former is metered separately for electric stoves each family has not and for other power uses, like a washing machine. You know there is a special low rate for a power time. The lower voltage takes core of the lighting and has its own meter. All electric and heating bills are divided

To bring water to the bouse from a main 600. feet distant, the water company asked a dostara foot for digging trench and about the same for two-melt pipe. (The extra size of pipe allows for distance and for future contingeomes.) The owner devided that a little pick-and-shovel work would be agreeable and credited himself with a saving of \$600. He hought anivamised pipe and connected it himself. It cost less than \$500. The total saving was 4000. However, it must be said that the water company pipe, being a new alloy cast tron, is a superior anaterial.

TWO-CAR garage with ceaseat floor and with steam heat, light and water obtained from the house, comparted the unprovements. A builder estimated the garage to cost \$780. The owner did it himself for \$180, partly by using surplus material that had been lying atound

"Some day," I said, "there may be an argument over the coal and electric bills

Joseph Penka hoghed. "I expected that one. The steam proces are laid out so that, on short notice, I could put in another boiler and let the other family do what they pleased. It as the name with the cheetical wiring. I man have separate meters installed.

Perfumed Anesthetic Is Latest

THER masks seemed with perfume are the latest surgical novelty, according to Dr. Gohrbrandt, German physician. The namesting smell of the anesthetic is said to be eliminated, and the patients go quietly to siero ta comfort.

Women, particularly blondes, are as a rule much better at receiving anesthesia than men. declares an American dental expert.

—A Clarinet Player''

Today the demand for chriseticts of a de all there when you can play a for rest there are good position readly of you and real fundament to a pay pleasure and spart time or dots they you objects a chargest its easy to learn to play a

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. and then the program stopped!

RIGHT in the middle of the Eveready Hour. A good program. And then . . . nothing! I got my flashlight and went over everything. Found a broken lead-in. Fixed it. Everything jake again.

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compound to your Presto sure tank will do soldering. note. No fusing and on tent time. Cher scott lens and No set or opened potential. Torch No 21 with four rice seddering copper hose \$7.50 and connection for Presso same panic. ST. PAUL WELDING & MING, CO., 100 W. Mr. St. St. Part, Mine.

Romance Jams the Log Jams

(Continued from page 15)

lumberjack for camp were neither so tough nor so herose as the lumberpacks of fiction. River driving is a business, not a melodrama. It's a colorful and often an exciting business, but it's a business built on these three solid factet Water will run downhill. Logs will float. With anything like decent water conditrops, logs can be driven from the woods to the mills a lot cheaper than any subroad could carry them.

The business men at mahogany desks in steam-heated offices in Montreal and Portland and New York who gull the strings that send millions of logs rushing down porthern rivers on the freshets of May and June do not think log draving is a declining business. Each year the woods arous must go deeper into the back country for their logs, so the tendency is loward longer drives and more efficient drives -draves that move faster and leave fewer logs stranded. Each year numy thousands of dollars are spent improving the rivers that carry their devices basising away troublesome boulders, and building heavy crib work to keep the logs running free in the chancels.

BIT about these dollar-and-cents details the lumberjack refuses to fret his carefree woul. He toils and eats his beans with a mighty. appetite, and when the drive is down spends his pay in the time-honored fushion of his kind

Conditions vary with localities, but in New England and costern Canada the cutting crews fell trees from September until spring

When winter snow makes what ohi Joe call-" anod slippin for sled tunners, teams has! great loads of the logs to the frozen streams some are "landed" on the ice: more are piled in great "zwiways, on the steep banks. When spring romes the break up of the are carries out the "landed logs bleesking not the rollways is a dangerous and spectacular performagree that demands a clear head, quick with and ague histy. Many a hunterpick has their in an unexpected enseade of page

I must see seal old Joe, "I was poken away at the key top of a rollway and abe wouldn't budge. I got mad and hooked my peavy into that old log and pulled for all I was worth. Thit she came and the whole kit and culmodie of logs came down on top of me. Test burt! Not mo! Not a one of them tetched me While the boys were lookin' for my remaindown on the bank, I climbed up and hollered to them. Most susprised bunch over I seen."

Most interesting is the Androscoggin River drive that starts in the Rangeley Lakes district of Maine and ends at the nulls of Berlin, New Hampahire. It isn't long as drives go, but in its fifty-odd miles it includes almost every variety of log stressing.

THE bulk of the logs handled on this drive are cut on the aboves of Lower Richardson Lake, touthernmost of the beautiful Rangeley chain of lakes. These logs are chained into great rafts and towed down the lake into Rapal Haver. Old Jue took me to see the logs sluced through the dam into the river. The blue , water of the lake was curpeted for the space of several rety banelot with hobbing logs confined and controlled by long boons of age changed. end to eno. Over the slufting from lymberpacks gav with bright checked shirts skipped moreov the calks-half-meh steel spikes and their driving boots giving them momentary footholds. On the dam other lumberjacks, armed with pickpoles, wanted

Then the sluter-gute was raised, and the lake water a good seven feet above its normal level. rashed through the narrow opening and leaped moring twenty feet down to the rocky bed of Rapid River. On this water rode the vanguard of the drive-foor-foot pulp logs that were carried down like (Continued on page 241)



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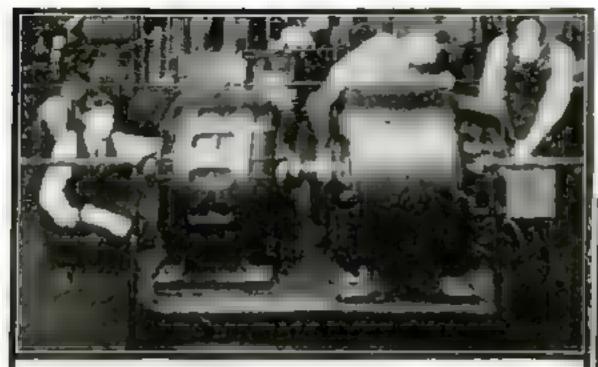
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A Glimpse Into the Coyne Electrical School

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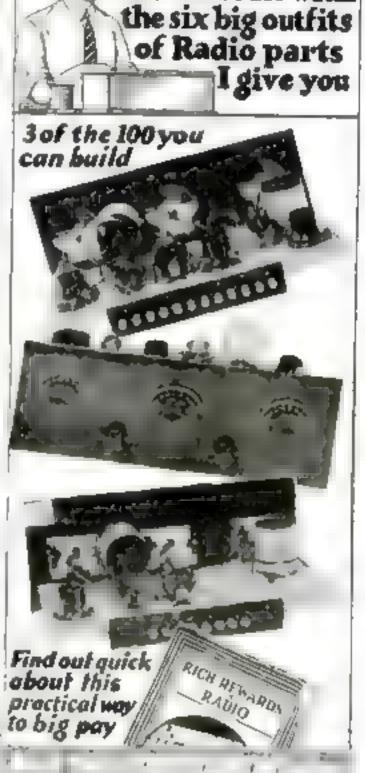
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Romance Jams the Log Jams

(Continued from page 143)

match sticks, long any logs that emaked on the rock-strewn river bed, up-ended rebelliously for a moment, then too were carried helplessly on by the unleashed water. On the damthe men with pickpoles worked like demonst to keep the logi end-on to the current and runuing frue, for a almoeway jam is the meanest work. As the boom began to empty a windless was manned, with much shouting and singing, and the boom logs drawn to toward shore, thus herding the outlying logs toward the dinceway. boon the desired number had passed through into the river, and the gate was lowered.

Pollowing this section of the drive three miles down river, we found the logs floating quertly in deep water behind Muidle Dam, and in charge of a new crew. There the shucing process was repeated. Sometimes a single drive crew takes the logs from the woods to the mills. but on the Androscoppin drave, and on most other big ones, the dams divide the river into sections, each manned by its own crew, which hustles the logs to the next dam and then lets the other fellows do the worrying

After six miles of the roughest sort of white water driving. Rapid River hurls the logs into Umbagog Lake and they are towed into the Androscoggia Rever. The logs are sluiced through several dams, and there is plenty of white water driving on the Androscoppe be-

fore they reach Berlin.

"I WAS at this drivin' game for forty years, until the rheumatism made me a harbeen," volunteeers old Joe as he spun the starter of the outboard motor and we started linck across Umbagog, "It a a tough life, but it a hard to keep away from it. On the Andrescoggin and the Discounds I've driven logsand on the big 'moressin drive' up in the Bt. Maurice country in Quebec. They call it the moceania because you never see a past of calked hoots on it. Those Canadians up that way like to do their driving from causes and them there hateaus of theirs-big flat-bottomed boats something like a dury, but with higher hows and stories that can go whooping through the characlest rapids you ever any without taken in a drop of water. These fellers—there a a lot of Indian blood in most of em- are the best white water boatmen you'll find anywhere. They can make a ounce sit up and talk.
"You been in that country? It's tough

workin' there—dead cold in winter, and manquitoes and black flies to drive you crasy in summer. Up there they don't call the forests the 'woods' or the 'brush.' They call 'em the bush.' Pellers my they re goin' late the bush just lake a soilor says he's goin' to sea. And it's just an easy to get lost in the bush as it is to get but at um. I've heard a pack of wolves bowlin' not ten miles from La Tuque, the biggest town there—the jumpin off place for the bush The same company that runs this drive here on the Androscoggia has a big pulp mill there. and owns timber limits up the St. Maurice

"How do those companies know which logs belong to them? That's easy. A brand is cut in both ends of every log. Up above La Tuque the company I worked for has the first surring gap on the river. A long boom stretches across the river, and in that boom there a left a parrow gap. There's a platform built there above water level, and men working un it work the logs crosswire to the current, so the cleats on the endless chain of a power conveyor pick them. up. On a higher platform sorters look at the brands. Logs that have their company's brand they push off into the water, where they are held by booms until the pulp-crushers of the La Tuque will need them. The conveyor throws the other logs back into the river below the booms, and they float on down-

"You say (Continued on page 152)



Look What These Cooks Trained Monare Earning

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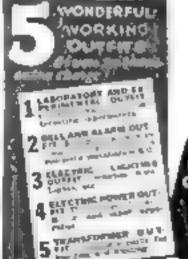
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Romance Jams the Log Jams

(Cantinued from page 134)

lumberiacks aren't what they used to be."

I commented, "How are they different?
Well," and old Joe, "there's a different class of men in the business. I sed to be a mun was a lumberack and nothin' else. He worked in the woods all winter, and on the drives in the spring, and then when he'd get. paid off he d go on a bender for a couple of weeks, and then loof until September, and go into the woods owing the company money for his outfit. But a good many of the fellers that work on the drives now-a-days are just [laborers from the big cities. They don't take any pride in their humaness. Get their money a maget back to the ritues.

But the rea sumberparks still spend their money pretty free y Some of them blow it on beause and a good time. But the younger felless don't de that an much. Clothes is their delight buy some of em will come off the drives, and willout waitin to take a both even will get ragged up in an outfit fit for a city dude. Maybe they re more moral than we used to be. but they aim that good at breakits down a jam. with the while water clutchin at their legs, and death hangite over their heads. No, set

A New Brood of Lindberghs

(Continued from page 30)

with him and if they, too, report his one hopeless, he is masked out-

Promotion to solo flying brings the reward of two thights a day-half an hour alone and then half an hour with the instructor, learning new maneuvers for the next day's practice.

The beginning of anloung brings the most thrilling experiences of all, but endets are forbolden stant flying. On a clear day this rule can be enforced easily enough, but when the clouds hang low it un't so cary.

Along with his pressary training in flight, the caslet has devoted part of each day to technical training on the ground. He has studied the airplane engine until he is thoroughly familiar with every part. He has mosterest stetards of the rigging of airplanes. He has exrued the principles of navigation and how by one navigating instruments. He knows how to send and receive sumars by radio, and has practiced communication by band and light I signals and current pigeons. Even meteorology and some astronomy have been learned.

AT THE end of eacht months be completes has primary training, and is a full-flesteed flyer. There remain four mouths of intensive maitary training in the Advanced Plying School at Kally Field, San Antonio. There he handles every type of service plans, from the speedy little pursuit ship to the guist multi-engined bomber. He practices military formations and evolutions, flying wing to wing with his consradet at 150 males an hour. He flies through fog and storm, and tries his ingenuity at maleing forced landings in tight places. Perhaps, even, he experiences his first forced parachute jump, as did Landbergh during his cadet days.

Not the least of his achievements is the abilits to fire a machine gun and hit a larget from has smittly morning stop-

At the end of a year he has flown for more than 200 hours. He is an expert pilot, equipped to meet any emergency. Gendunting, he rethe Air Corps Reserve, subject always to the call to active duty, and is in line for a commission in the Air Corps of the Regular Areas

Whatever calling he may choose to follow, the year of strengons effort and adventure has accomplished a two-fold purpose. It has passed has to a place of leaders to an the caules of aviation, and it has milied new strength to the nation a air defenses.

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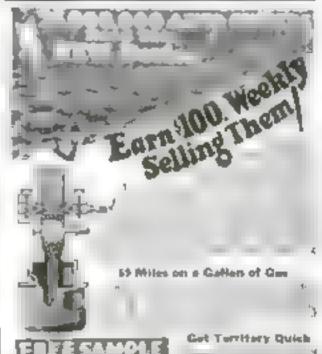
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Whirtwind Mily. Co. 1911-182E. Third St. Blummken, Wiesers

Our Battleships on Wheels

(Continued from page 48

soon afterward German shells began dropping about both.

The next clear day another German busaard came over, and then we got a bad dose day and night for forty-eight bours or thereabout. Guns 4 and 5 got the worst of it. First the bussard dropped bombs near 4, then the Germana resumed their bombardment of Belleville and its bridge over the Meuse, near our poution. Some of the shells struck within twenty or thirty feet of our berthing curs.

NexT day, the 29th, three of our men were budly wounded. It was now almost November, and the Meuse valley was many and raw. We were afraul weather had affected. our powder. If it got too cold, it lost its punch and wouldn't drive the shells so far decided to ateum heat the aminumition cars and tour 5 started to try it out. "Means fitters among their versatile crew started to lay a Steam pipe line from the locomotive into an amountains cut. They were working out in the open when a shell lattiled and bit A. P. Sharpe, K. W Cuthrie and A. J. Burbette. We sent them to the Army hospital at Glorieux Next day Slurpe died, first of the crews of our battleships on wheels to be killed by the Germans. The others recovered

On the day Sharpe died his gon, 5, started with 3 and 4 to even up by firing ten shots each into a mass of German troops concentraining at Mangiennes, about 26,000 yards away Next morning Gut & back from the Lann front, reached Charny, about three miles nearer the Germans than Therville. From these we fired our first shots at Montmedy, six, at \$7,592 yards. The gobs went through a German bombardment while firing Shells lauded between the gun and herthing cars and killed three American engineers working on our track. They blew the headquarters mr and one berthing our off the track, but we got them back.

But there was fun, too. Souvenes were plentiful. Pretty som we began to look ohe a war museum. I got a dereliet Prench box car and put a gob in charge who took all souvenire and issued checks. Thank God, the Germana gever hit that rur

Laberty purises brought little stoves from Everything was all right deserted Venture unts an Army general came around inspecting and asked where the stoves came from

"General, I said, "the weather is getting wintry. A few days ago we had a beavy storm, and if just rained stoves. We shut all doors and I windows, but a few stoves blew in somehow.

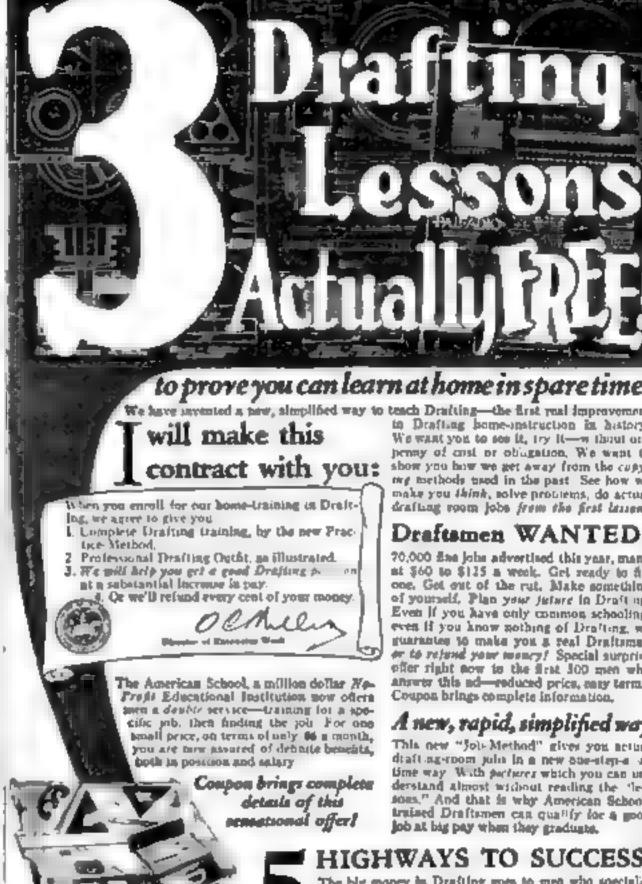
The general said no more.

OW Marshal Foeb was planning another great thrust to envelop Meta and throw a French and American force under our old friend Mangin and Lient General R. L. Butlard into German Lorrance, and on to the R: no. Guas I and 2 were sent south and were ready to shell two important railroad centers. Bensdorf and Soarburg, when the armistice

came November 13

That was because of the great success of the general offensive starting November 1 in which Guns 5, 4 and 5 played a valuable part 41 dawn that morning they started firing, and Gun & joined in for a while Eighty-one of our great shells fell that day upon the two vital functions of Montmedy and Longuyon. The Germans tried to use the railroads to the utinest, in reinforcing their wavering front, and our shells fell just when and where they

We fired an even hundred next day. The doughboys had broken the German center, and were pushing straight for Sedan. Now no never they needed support, and our hattleships on wheels gave it. We sent for more amounition, and we got (Continue) on page 144)



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Tom-"He certainly has come up fast He wasn't getting over \$50 a. week the last time I saw him-How'd he do it?"

Bill-"Took up a course with the L.C. S. and studied at night. That's why the old crowd been't seen so much of him in the last few yours. I wish I'd had the sense to do it too. I'd be making more money right now if I had."

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Our Battleships on Wheels

(Continued from page 144)

enough, though none too much. We had brought to France powder and shells for 300 shots by each gun, 1500 shots m all. We had fired nearly half and not all the rest was at

On November 5, while Guns 1 and 2 were 1 preparing to leave for the Meta attack, and 3 and 5 doing work necessary before firing again, there came a hurry call to fire on two smaller junctions at Louppy and Ressouville, respectively some \$0,000 and \$8,000 yards, where our aviators reported German troops concentrating. A German aviator over Gun 4 watched the whole process. That evening shells came close and fragments struck the brackjuarters car

tion I opened the hall between 1 '99 and 5.50 the morning of November 4, dropping shells into Montmedy German shees fell close again, and G. P. Burke was sugarly wormsled.

Meanture Gun 5 had mealed up to Clurny at two o clock in the morning and fired fiftyrix shots into the radroad yards and at the tunnel at Montmedy. Eusign W. C. Davis checked the aiming angles G. K., and Lieut. W. G. Smith, commanding Gun 5, was sure he had done something. He had. The lower yards at Montmedy were in flames. Our builteships on wheels were officially credited

Brigother General Hugh A. Drum, Chief of Staff of the First Army, wanted us especially to cave in the mouth of the tunnel. It was a miall (arget, but on November 5 Gun 5 threw 6fty shells into the town and yards. On Nov. ember Cammunition was boking. Next day the firms at our favorite target commenced again. Then came the beginning of the end. As General Pershing puts at-

WE HAD cut the enemy's main line of communications. Recognizing that nothing but a resention of hostilities could again his armies from complete disaster he appealed for an ammediate armistice un Novcruber 4

But Marshal Fresh didn't quite trust the enemy and the Albeit Armies kept closing their jaws and we kept on dropping our great shells into Longuson, Montmody and Mangiernes. We got off fifty five shots and spent most of November 10 waiting for assurance son.

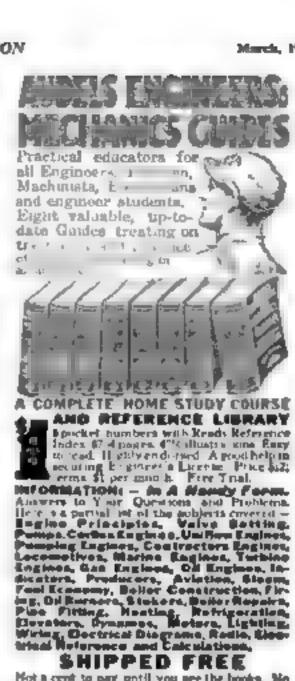
The next morning the war eroled, and we sent over ten black periods to mark finia. They were all fired from Guns 4 and 5 upon Longuston. Gun 5 stopped firing at 10.56, four munites before the Armester Com 6 s last shot was fired two minutes later. Seaman James A Kaffka worked the firing key. It was all figgred out that the shell would land a few seconds before 11 o'clock, just mister the wire. We gave the primer to Admiral Earle, who had first inspected the sales of the buttleshaps on wheels on November 12, 1917, just a day over one year before.

During our firing in the greatest American builtie, there had never leen an American auplane to spot for mt. The Intelligence bervice had sometimes unit us reports of results, and a territori presoner sout he bad seen one of our shells blow up a troop train, but as mon as possible we went to see results for ourselves.

Lacut Blanden, a professor at the I poversity. of Michigan, on November 12 west over to Montinedy through the German lines. The French people in Montmedy greeted him as their majour after four years of captually

One shell had but the bendounters of the Seventh German Army and killed or wounded (wenty-eight of the staff,

We had hat the tunnel three times, but had here unable to cure it in. That was because the delayed action fuses had not ret come from the States. The pext day Commander Bunkley and I went to Louppy and Remosville and found (Centiment en maer 1461



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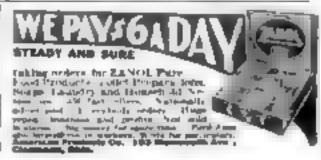
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there yes THE LEWIS PROTITORS. Dale of, Mich.



Our Battleships on Wheels

(Conbaued from page 154)

fourteen shell holes about thirty-three feet in diameter and eight to eleven deep, two right in a former ammunition dump and most of the rest within effective reach of the milroad bridge midway between these two towns.

We had cut the main German strategic railroad in the decisive stage of the greatest battle. in American or world history. General Pershing

wrote me after the Armistice:

"Permit me to express to you and to the contingent that served the naval guns under you my succee appreciation of the very efficient manner in which they cooperated with the arthrey of the A. E. F.

"Your command has performed a distinctly important service, and I found you at all times eager to carry out our plans in a true spirit of

endperation.

"I should be very glad to have you express to all concerned my sincere thanks and appreciation for the work accomplished.

PASSED on this prame with interest to those who well deserved it, Commander Hankley Commander Schusier and an the other officers and men who belped so loyary

Well, the war was over. Now for Peace and Home. We west back to Haussmont and the night of November #3 we had a big movie show and on the spur of the moment, I lasked a little to the men.

"After our experience," I and, "there will never come into my mind any question about the American manhood meeting any situation. After we had finished the Battle of St. Namure I knew this outfit would go to Berlin and nothing would stop them but the

Germana have given in and we are going home.
"In all our joys and gaseties, in connection with this performance here, we must not forget those men of this force who started out just us full of this as we did, but who have fallen by the way side. It is not possible for a hunch of people to tackle as the things we have tackled without somebody getting burt. But I am happy to say that all three of these men were hurt directly in the line of duty. They are "C, G. Russell, lost in Philadelphia.

"Thomas E. Price, died at Madly from walking typnoul.

A. P Sharps, killed at Thierville by a German ahell

I ask you all to rise and sing with me that

famous old hyran. Abule with Me

One thing all those gobs wanted before they went home was a good look at Paris, and I thought they had it coming. The Parenans, too, wanted to see our big guns that they had heard about, so on November 88 my faighip train put off for St. Nazaire- via Paris and the five gun trains came along after. We drew crowds that stared as if now they began to understand why the Germans bad quit

ON DECEMBER 11 all the trains had returned to our old battleground, St Nazaire. Within a week all but one officer and twenty men, left to dismantle gun cars, were on the ocean homeward bound. With my executive officer, Communder Bunkley, and most of the men I reached New York Christman Eve, 1948. My only regret was that I must say good-bys to so many true-hearted comrades who had mode successful an enterprise such as few sailors ever undertook. One of my keenest pleasures now is in foregathering with one of another of them, as I often do.

I like to recall our inland voyage, and to remember that as a result of it, my country is the better prepared against attack in another war. For far at sea, a hostile fleet would be struck by shells of even greater power, fired an even greater distance by bugger guns, drawn by trains moving more swiftly-thanks to what we learned on the land cruise of our battleships on wheels.

SEND FOR THIS MOOK LET GEORGE HERE'S YOUR CHANCE! The Mr opportunity you's about wanted to have entra quelty bill; Mr at the year of the tender of the Mr T Nicore will find binder made a bet profit of the 10 M Gabe. They can do not be under the every space bout the Mr to to profit with the SHOW LAST SEASON IDEAL LAWN MOWER SHARPENER W. F. Sarndy, Buffan, writes. "I sharpened who nave movers last manufacture receipts were nearly 17, 27, 20 which is not bad for a Visit law, the make positively independent, outlid a perminnent is districted by the making functions with this index. I statist to winders full offer the store that extends also because of towns more resolutions of the store that is the store in the store that the store is the store that the store is the store that the store is the store is the store of the store is the store of to which is not bad for a alde une 1820 IN 15 DAYS Report Francisco Marches was the first of the state of th Man, It's America How Easy that to make odd money with the R. J. Nulses. In Thomas Name corned the grinder business over to his 14 year old win. OVER IS,000 IN USE Handrada of Dall Mewore in past totality to be sharpened. No town too small. R. S. Newtonian' Visit on a writer in the deep one for pality available and other sweap to det their members ground. A surfaced starts also will be out to The Ideal sharpened to be seen to mean sugar. Oursess are stouched or all their Principle past to be surfaced by the past to be surfaced by



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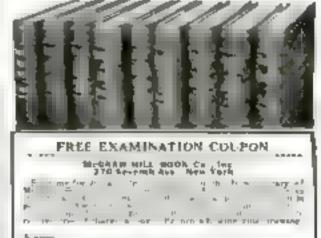
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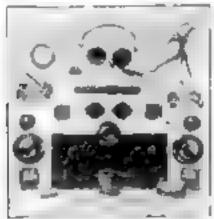
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All Metal

(Continued from page 40)

hour, Jack Page figured he most have passed off the end of the point, and out to sea, long sore. And he had

The third boar of flight brought nothing of improvement. If the fog would only break for a second, merely give Jack a peek at the sun's pusal aug.

"comething clie went wrong. Cheese came to a standing lean in the gangway and intened Jack's heart stopped and his eyes went in the instrument board. "Trouble travels in mobs!" lack barked. "The Liberty's burned out her generator'

For a mante, the high note of the Pacific Gulf's three-toned drone had fallen. Then, before the Laberty could quit entirely, Jack had switched her ignition over to buttery For an hour or so, the motor would continue to operate on that some of supply. But, after that, with the Liberty "It's twenty-four purps sparking from one small hattery, the juice supply would become exhausted. then the silenced motor, weighing at least 1500 pounds, with radiator and oil tanks, would become a heavy, weless thing

WHEN the fourth hour ended, the sum was the Liberty, and it was "missing badly The deseptions had gotten to its ignition, and the big motor vibrated and shimmed through every plate and rivet of the all metal field. Jack Page knew that motor wasn't going to be with him long. Also, he realised that to keep it running might mean damage to the gambine feed times of the other motors. But to kill the Liberty meant to carry its dead weight. Then, with four hours gusobne supply gone, the other two engines would operate only one more bour at the most Jack came to an all metal, large-sized decision. He would try something that no other pilot had ever level put to be decided not to carry that dead motor

For a number he and Cheese talked. Then the latter secured took and took on a big joba job of daring

Cheese went through the small, forward calun door and across the cat walk to the namelle of the right wing a motor. Once there, be bestied down and unfastened the drift wife. which ran upwards to the Liberty's radiator bed. Then, with the wing end of the drift wire, he made his way back to the ship and entwared the free bit of the line through the exhaust marrifold. Meanwhile Jack was running all motors at half-speed.

NEXT, Cheese freed the four hold-down draft pins which held the motor bearers to the nose bulkbead. With the safeties freed, Cheese lightly tapped all four pms until they were ready to slide. Then, moving across to the left wing a ascelle, he loosened the second doft. And with this were in band, he returned to the left door of the cabin, crouched just mode, and waved an O.K. back to Jack.

Then Jack Page undertook the thing that no pilot had ever before tackled. He shwly eased full-power to his two wing motors and won a little more altitude. Next, even slower, he pointed the Liberty a throutle wide-open, and she vibrated beautifully! When the Liberty was thaking the ship as no ship had ever been rough-housed before, Cheese mapped the left ded! wire forward and into the whirling propeller. With a sickening job, the propeller shattered and rattled its broken bits forty ways against the all metal surroundings. With a murderous vibration set up, the craft pulsed wildly in every plate-seemed as though it must be torn to pieces. Another wrenching and tearing, and the thing was over. The Liberty had been shaken out! And the Books rhecked it in. Broken-blade vibrating will do rt every time. (Continued on page 187)



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All Metal

(Continued from page 166)

With the great weight gone, the nose came up. Quickly, Jack whiled his automatic stabilizer's adjustment wheel and made the longitudinal correction. Then the Pacific Gull sailed blindly into the fifth hour-

"You win, Jack," Cheese and. "Thought

she'd konk as!"

During the fifth hour, visibility over the water became better; and it was early in this boar that Jack spotted a ship, a great black liner coming heart-on.

"That a Maru boat?" Cheese cheered. Then, a minute later- " And she a the Total Marie. . . I know that baby; I've seen her in

"Well, that's good and not so good," Jack answered. "If she's beaded for San Francisco, then we've been flying for Japan. And if she was three hundred miles out early this morning, she s still farther out than our gas il alretch. '

JACK tuened the Pacific Gull about, took his direction from the ship a, and started for where han Francisco should be. Then, after a few minutes of flying and thought, he turned back and headed directly for the Toino. Cheese said, "What the h-f"

"Slide in here beland the controls," Jack told hun, "and fly in circles above the Tokso

winks I talk to the passengers.

Jack passed a word to the girl and went forward through the companiousny. I ponreaching the lady and her three buy friends, he stopped for a moment and assured them that all was better than well. Which was a lie, and Jack knew it.

Upon reaching Mr. Deuse and the four government men, Jack ganged them close together. He punted out the Tokus Morn and

talked samently.

"These seat booths," he said, "are corkloaded and self-righting. You might get a attle wet, but that a sil. It's a cinch I can't carry this load ashore, so, you'll get wet any-

way. What do you men say?"
"Listen, pilot," Mr. Deum mid, "You're cuptain on this ship, and what you my goes. If you say thin thing to the only way out-hop. to it. Tell my little girl good-by. And I'll meet her in bon Princisco.

"And you?" Jack asked the government

FOR a few seconds they granted strange grins and looked from one to the other Then, as one, they and "Shoot! You promised to get us to the Tokio Mora, and we Il tell the official world you re doing it!

Thirty seconds later, Jack was back on the

He spoke to Cheese, and at the same time reached to his instrussent board and opened a amal, door behind which were ten short levers. Each lever was numbered. "Go forward," Jack sold, "and somes the lady and her husbands. . . Keep their eyes to the rear. Then explain what happens in your own apt way, Chrese."

For a few seconds, Jack studied the drift of the Tokio's amoke. After climbing two thousand feet, he flew slightly up-wind from where he had last seen the water craft below the

chantels.

In the cabin, Cheese once more checked over the safety belts of the five men who had wanted to reach the Tokio in a hurry. Next he moved to a position behind the four rearseat passengers and attracted their attention by starting an extemporized lecture on the advantality of looking to the rear when flying in clouds. He held their eyes. The five men up front held tightly to their seats.

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Jack Page reached out and pulled five small levers. In the cahin, five square sections of floor elieked back (Continued on page 148)





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Then. dista . .

All Metal

(Continued from page 187)

into place, and the remaining four aerial wanderers wondered at the great empty space where, accouds before, five nony men had sat and talked.

"Where are they?" the lady demanded of Cheese. And she posited at where they weren't. Her three men echoed the question

"Where are they?"

"Ah," Cheese smiled. "That is the question? . They've gage down to the lower deck for a amanike.

"I didn't know that there was a lower deek," the lasty exclaimed

"It's a big ship," Cheese answered. He went through the companionary. And said a "Yes, the Tokio Mare has many decks."

"Oue . . . two . . three . . four . . . five," Cheese counted as he gazed down over the cockpit's gunwalt. "They all got away, Jack, and with clean openers."
"Parachutes" the god discovered. "Where

did they come from and who are they?"

The nearest one to our tail, Jack told her, is your dad. The other four are carrying the government hove. They to going down to the

listso Mare. That comes of being in a burry. "But me," the girl cried - why was I slighted? I have always wanted to rule a parachate."

MR TOO," Jack hughed, "but it's a thing that one wait. I released those parachutes when I sprung these levers," he explained.

"But the parachetes," the girl asked, "where

were they's

"The parachute to each reat is packed away under the central walk. When the booth drope through the trap door, it drags lit attacked parachute out for a positive opening The siles is Cheese's. Also, Cheese had the sies that laymen must be dumped

turing down, Jack brought the Pacific Gull up over the Totio's stern. Already the parachutes had been sighted and the highreejudging by the white fount along her sides had reversed her screws and was standing by On the best deck there was much activity much menething was on its way down from the day its. The Japa were prepared to pick up the jettwoned hye

REMEMBERING his own troubles, Jack Page again judged his line of flight from the Tobic r him and he tailed into the east. Looking back, just before the clouds once more blotted out the scrue, Cheese cherted "Some shooting. Jack some sharpshooting, Ill say! You put Mr Dense right anto the There canother right in Folio a raggings." pear her to a The third down majorities

And the other two a few hundred feet

"I should have dumped the others, Jack now decided. "The whole thing went off so smoothly. But I knew they d yell tilue murder. if I told them what to expect. We'll have a chance now though. If we can't make labil, the Folio wal be along to pick us up; that is, if our flotation chamiters work as they should . . . And it won't be long now because our gas is just about out."

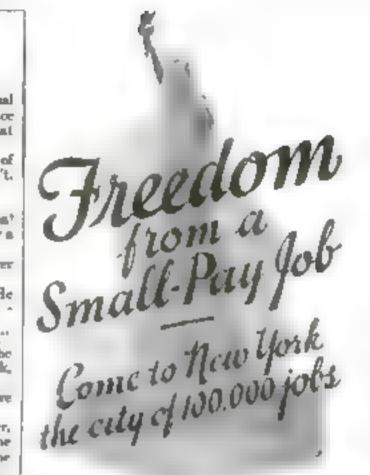
'Maybe you're closer in than you think," Theree suggested. "And perhaps we'll make it.

yet.

Maybe. Jack mused, is a good acronautical word. But surply possible never kept any plane on the wing If we do it. Cheese, it will be food-sent, and I dog t mean

Another ship!" the girl shouted. She pointed dead about. Out front, a few miles, a some thing was plying its way shoreward.

When they could ascertain its color, Chrese placed the brownsh-red craft as a Matson boot. "The (Continual or page 150) (Continued on page 159)



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All Metal

Hilo." he decided. "That s the boat that our lady friend and her three yes-men want to ma ce.

"Cheese," Jack said, "go forward and take a look at four safety belts. I promised her I d got them to the Hillo in tune, and I'm as good as my word." Quickly, the willing Cheese was gone.

"And what about little me?" the girl asked. "Do I go bye-bye this time?

"Not so a you d notice it!" was Jack's backwaste "Next"

Everything a set. A herse came to the passage and reported: "and all four are state kuking up. Want me to show them the way down, Jack?" As he spoke, he was making Pear Y

"Want to go, Cheesel" The question was feolish

"Every pound counts, Jack; and I'm no lightweight. What's more, you have no real usuforms. . . . I'll go down and have the Helo wireless the Coast Guard to be on the lookout for you."

CO-LONG, Cheese - they shook bands-"and have the Hills on the lookout, too teet into that seat. We'll be up wind from the boat in a shake. Step on it

Seconds later, they were abreest of the steamship. Jack made a few brief remarks to the girl at his side and pulled five more small levers. With her head hanging from the cock pit "One two three . four five," the girl counted. "They we all opened."

Back over the Pacific Unit's tail surfaces. Moss Densa continued to watch. "They're lowering a boat . . . Two are down just behind the ship . A third just abend The other two behind, so close I can't see them . . . Good shooting! Fine sharpshooting, I'll my, Jack

"(Hi, boy" Jack granned "I d sonner be up bere than down there in Cheese a boots

when that old gri is fished out.

"You and me both" the gri studed. "Think they re still looking up? Or do you suppose they we caught assuckness from too match free sir?"

They wanted the *Hilo* in the worst way, Jack ground, "and they got it."

"In the worst way," she added.

FOR a while the Pacific Gull droped above-ward. Jack studied his instrument-board telltale glasses.

"I don't know what the's dying on now," be mused. "because, according to the glames, all the gas is gone. . . . It a ten after four And still ahn carries on. All metal, my ship is And her motors and spirit, too

"To say nothing of her poot," the girl add-

ed. There was a long silence.

"I have one more card to play," Jack and at last, "If the Gell is all that she should be, If the won I she L cruise on one motor then you and I must get set for a wetting.

"If you built her that way," and the girl, "then ohe'll do it

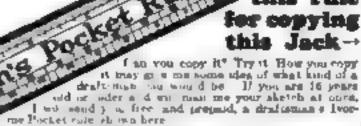
Jack out the switch of his right motor, the wing fell a little till he "pseked it up" with ieft-rudder, then the Pocisc Gall, at reduced speed, craised on. "That will mye half of what gas is left-if any," he said. "Muos Deuss, hold the lobe of your left our and

"Look!-the shore line!" Juck pointed. The clouds to the east were on the blow. Now and then they lifted. And, here and there, the mainland came into view; it was perhaps twenty miles away " Now is the time, Pocific Gult. Jack exported, "to prove that you are with me, and believe me, Gall, you re a gone gueling if you don't do your stuff now!"

miently, tensely, Jack watched the directuna of wind-ripple (Continued on page 160)



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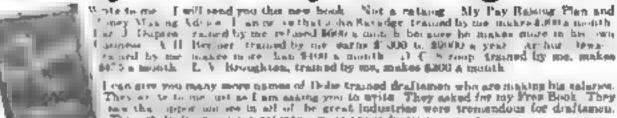
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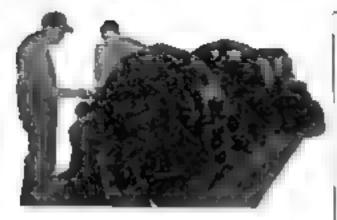
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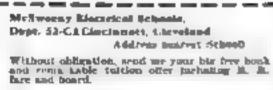
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on the water below; it showed that he was being favored with a tail-wind—a breeze from his tent which would belp carry the Parishe Gull through these last few tight males. Fverything a coming our way he said and told the garl of his latest good back. "It like the drowning man and his straw, Mea-

First name-Almira Al for short," the ger told him.

Well, Al-we're like the drawning man

we'll reach for anything now."

"Well, reach for that shore, Jack, and reach hard," Almara -Al Denn niged. "But if you don't reach, Jack. . . . My! what a man-stard try you ve made!" Her voice, like all else, ecemed slow

In the ages that followed, there were slow males for the hard-put Parific Unit. At last, with only a few more unles to go, the single muster konked, flatly, and almost quit. Quickly Jack dropped the left wang lower to drain all possible gasoline loward the dying power plant—and, with a new bark, the engine came to life. In the gas-lines, perhaps, a few pents remained.

"HIS is what I call being hard-up," Jack I took Almira, "and if you could handle the controls, I'd go forward and squeeze the never quit the nearing shore, and he assled -"M gish, girl, this is the time and place for the augmented orchesters to strike up "California, Here I Come, and they d better bear down heavily on- Just Open Lp That Golden finte .

A flock of shore-scavenging gulls were taking their evening knock-off from work on the brack sands of San Francisco's long Pacific waterfront All attention, they watched and windered at something that came a-fluttering toward them across the wave creats. Then, with a wild scurry, they took wing and quit the sands to make room for a real gulf The Pariete Gull came a-rushing!

For the last few hundred yards, Jack Page came in on his ship a glide. The lone motor bud gurded and gone out of business for keeps But guding momentum, plus her flotation chambers, plus the agus-dynamic force that carries a surf-board stop the crest, all josted in rolling the great, spent Gull high and dry upon that deserted strand

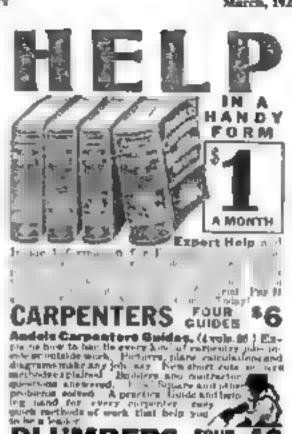
The Coast Guard erew mine running. At first the goards thought there was only one person in that aft cockpit. Coming clove they learned that two can sit as close as oneand in the same control rest.

HOTES later the Wile made port. At about the name time, the Total Mars need into ber berth. And, among the 'chute-delivered ten, there were no sorehends. Even the potent hily with three men was not displeased with the adventure "Thrilling!" she avound. "In all my life, no trip like that!" But her husband, it seemed, had caught a cold from his unmerson. He own fault?" the lady told everybody aboard the H to. "When we can to Caufornia-two weeks ago -1 warned Horace against removing his flannels. But he would be a sport, and now look at him?

Cheese was sore, too. He had undertaken to teach a number of the Tokyo's brown boys one of our foremost national games. The session on knees came off in the forecastle, and the little brown cocsins had Imaght Cheese a few things that he had pever before dreamed of

Not many days passed before Cheese, in a San Francisco bangar, had a gang husy with the rehabilitation of the all metal Gall. Early one morning, Jack Page came in to tell them to take their time

"Do this job right," he mid. "There's no rush now, When I get [Continued on sucr 1811)



PLUMBERS AND ES department of the state of the

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All Metal

back we'll hit the ball and start all over." Then be used good-bye to the gang. Jack was on his way to England and the Continent; bent on the study of foreign airways . . . and

'He sure has the flash of a tin god?" one of the mechanics remarked when lack had gone. "Some brassy bird! Imagine this cloudbuster walking off with Big-Man Dense

youngest kbi.

"And making the old man like it!" another wailed. "Old Deum and all his jack! . . . My goth! what a cond-iron erest this steely guy has, and with all the high mucky-mucks in the Southwest trying to capture Almira."

"The god! ... Breasy bird! ... Cast-trott and steely " Cheese Farling came out of a rockpit feet first to exclaim "Well, I'll say you guys is right sell you say, all metal is what Jack Page is, brothers; ad metal!

Why We Are Immune to Some Diseases

(Continued from page 44)

exercised rata were ill, and five of them died Ten games pige were well fed, ten put on reduced het and ten actually starved. All were then infected with pneumonia. The starved pigs were given all they could eat and only two died. The well-fed group got all they could cut and five died. But the reduced-diet group got no fond after the infection, and neven died

" All of which seems to show," concarded Dr. Speeth, "you may be safer against infectious cliseases at those times when you are putting on weight than when you are in the pink of madition after a period of training of exercise."

Antibodies are of two kinds—those that attack the bacteria themselves, and those that attack the tuxins, or possons, produced by the becteria. The latter antibodies are called antigroups-some kill the bacteria by dissolving them, others "clump" them and still others umply "eat" them. These are called, respectively, lysias, agglutumes and operators.

THE Schick test for diphtheria momenty is probably the best known. A tmy amount of diphenentaxis is injected under the skin. If a red, inflamed area appears, you are susreptible—your blood contains no antitoria antibodies, to neutralize the potson. If you are immutte, no mark at an appears on your skin-the antitetin within you has immediately neutralized the injected toxia

Dr. Familiener endorses four rules to protect ynumel sprinst contagious diseases.

1. Find out by test what diseases you are immune to. Your doctor one test your momumity to diphtheria, smallpox and murlet fever. If you have ever had typhoid, cholera, smallpox chicken poz, scarlel fever, measles and mamps, you are probably immune to these

2 Immuniae yourself, by vaccination or moculation, against diseases you are not unmune to. A list of the sicknesses for which successful immunication has been found has aircady been given in this article.

3 Avoid channels of infection, as directed by local boards of bealth in times of inceptent

4. Observe general hygienic rules, particularly in regard to dentaliness, sunlight and

fresh air.

And you can't do much else against germs than follow these rules, the doctors ware. You can't escape them. Between 1400 and 15,000 microbes enter your nostrils in one hour's trangmil breathing. The only thing to do is to forget them, and hope that the fighting chemists and bacteriologists some day will perfect methods of immuniting against all infectious diseases.

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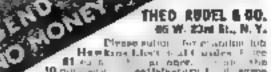
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They may offend others as much as these offend you

F some one you me. for the first time made the matakes in English shown above, what would you think of hin? Would be incore your respect? Would you be inclined to make a friend of him? Would you care to introduce him to others as a close friend of yours?

Those errors are easy for you to see. haps, however, you make other matakes which offend other people as much as these would offend you. How do you know that you do not hispronunces certain words are you always grammatically come to Lougas they may seem current but others may know they are wrong,

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Adores

Sperry—Competitor of the Sun

Continued from page 27)

enough to let the flywheel rotate inside the ring without touching it. And this occular rim was itself held in bearings in a "Y" But the bearings of the ring were a quarter of a curie or marty degrees around the ring from the bear-

The to a gyroscope, and except for suc and driving power behind it, it up I any different from the gyroscopes which are used in navantion, he said. A gyroscope is simply a fix wheel so mounted that it is free to rotate us any direction, instead of one direction only

He wound a string around the asle of the fivwheel and gave it a smart pull, and the little wheel spus like a top. "Try to turn it over by pushing against the rim," he mid. I was surprised at the resistance offered by the tiny mechanism. I turned the "') standard around and the spinning whiel dopped over,

THE principle underlying the gyrosrope and its applications is that every rotaling body lends to revolve in a fixed plane in space and counts every effort to change its plane of intalion, he explained.

The plane in which the gire rotates is a plane in space, which has no relation whatever to the earth shelf. It will keep rotating as that plane if permitted, regardless of the movement of the curth beneath it. Put it afford, as in a ship, and it will always know where the center of axis of the earth hes with reference to itself

It occurred to me that if a marner could always tell the exact direction from his ship of the axa of the earth, he rould tell in what direction he was heading. The gyrucompass points always to the true borth.

The gyrosteering device and the gyrodabilisee utilize the gyrocope i resistance to change. Metal Wike, as the gero beliamum is called, steers by the gyrocompass, which tells han the course. Every wave, current or pull of wind which diverts the stop a head from the true course gives. Metar Make a shore, and he shoves back, just us a human quartermaster would. But he is much more remative to the least variation from the compani course and his response is queler.

The gyrostabiliser is sensitive to the first impulse of the first wave, and gets into action instantly, steadying the ship before the second wave has a chance to get in its comulative effect. Thus it takes only weight and force coough to counteract the effect of one wave to

keep the craft on an even keel."

A Japanese cruser of 16,000 tons, taken out in a heavy ora for a test, rolled twenty degrees each way without the gyrostalasser and less then two with it.

Tiff plans now under way for a fleet of enormous passenger ships to run between England and America in four days flat call for their equipment with gyrostabilizers, Sperry toki me.

The first application of the stabiliser to airplanes was perfected in 1913. Sperry and has son Lawrence - later lost flying the English Channel-equipped a Curtist plaze with a gyroncope and sent it to the Aerial Security contest in France in 1914. The plane was fown with no other control, and a man walked out to the end of one want without deflecting if This "automatic proof, as the Errich called it, won the grand price. Out of it. developed the idea of the nexal torpedo, which is samply a pilotless surplane, carrying a load of high explusives, directed toward its distant target under the guidance of a gyroscope. seven of these built during the war hit targets thirty-five males distant on tests. The Armotice came just as production in quantity for use at the front was beginning.

"When did you first think of entering into

competition with the sam, Mr Spercy?"

"Now you are going back a long way "he smiled. "Back to the very beginning of my career And that started in Chicago, in 1980, October 18th my twentieth burthday. That was the day when the Sperry Manufacturing Company turned out its first electric dynamo.

and its first are lainp.

I drew out enough of the story of his boyhood to account for the man facing me now A Yankso boy from the oldest New England stock, motherless, brought up by his grand-parents in Cortland, N. Y. "A nuisance to the neighbors, I'm afcuid," he laughed, "making toy windmills, pestering the men in the newfull and the machine dinp gntil they let me use their tools. I blew up one boy with an experiment with beasing vapors, but fortunately he was not badly hurt. Another time I est a neighbor's back purch on fire

HE WENT to Cornell University for one year of physics and engineering and deested how to make an electric general or twice as efficient as became a dynamic which supposed the current for Brush a electric arc agent one of the marvels displayed at the Philadelphia Centrimial of 1878. Local business men put up the money and before he was nineteen, people were florking to see his miturle

Corrago was the place for a young man, the boy decided soon, and there he went. He built a tower—the highest in the world, three hundred and Mily feet—on top of the Board of Trade Building, and put 40,000 candlepower of are lamps on top of it. It was thirty years and more before the incubilescent light finally supplanted the are for street lighting, and through all that time Sperry was trying to make an arc lamp with more light and fewer

He did it. finally by putting a mineralised core into the positive rurbon. On heating, this produces a substance known as carbete, which has a besting point of \$000 degrees, and Fahrenheit. Carbon boils at \$700 degrees, and at that temperature gives of 100 enadlepower of fight per square millimeter of heated surfore and that is all the light which can be obtained from any solid at that temperature. In the Sporty are as high as 1900 emilliprower per square inflameter has been obtained The sun delivers to the earth only 1980 candispower for each square millimeter of its radiating surface, so the Sperry are is literally brighter than aunlight,

IT WAS the fame which his early feats in electric lighting won him that led to his being invited, in 1884, to join in organising the American Institute of Electrical Engineers. Later he called the meeting which resulted in organization of the National Electric Light Assertation.

He was first price in a competition for improved making mast mery devising the first electrical equipment for manny coal, Alii. 1993 extraserely. One piece was an "electric muse. with such powerful traction that a street-milway magnate asked openty to devise an electric street car which would clamb hills. He did. that, too, sold out his Chicago interests in 1893, and moved to Cleveland to manufacture street cars. Myron T. Herrick, now Ambassador to France, was treasurer of that openry Electric Radway Company which soon told out to the General Electric Company

Sperry then turned to making electric automobiles and in so doing developed a storage battery so capacious that it became the formustaon of a business which is still going on

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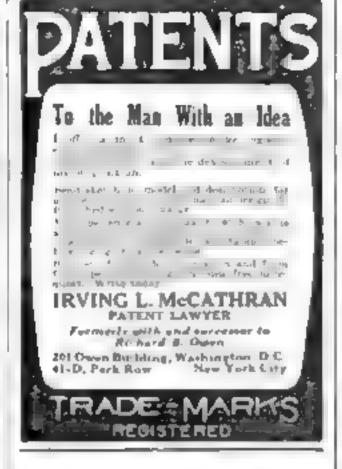
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Coal Too Useful to Burn

(Continued from page 49)

Moreover, thu new process is combined with another process for making ammunia at the portant ingredient of fertiliners. Both processes involve subjecting coal gas to pressure of 15,000 pounds to the square inch and pumping it through steel tubes containing ratelysts.

A cutalyst in a substance which induces or lustem chemical actions of others. The catalysts make the cost gases form methanish wood alcohol; and ammonia,

Here is an example of what may be expected.

from coal

Several years ago chemista discovered that carbolic acid and formablehyde mixed and heated under pressure form a solid materialnow cased bakelite after the inventor, Dr. Backeland. Used for pipe stems, radio diale and panels, distributor boses on sultomobiles. mulation, fountain pen barrels and so forth, bakehte and studies products have largely d splaced hard rubber. Constitutional matture farture of "cheaper" wood arcohol from coal will lower the production cost of bake ste berange formudeliyde at made from wood acohol. Bakelite will then be thoroughly a coulproduct and so even floor tiles may be made from coul!

Like a brick mason, the chemist rearranges the elements—carbon, hydrogen and exygen-of which coal is composed, to build what he will that is composed largely of any or all of these elements—theoretically, even rubber.

Probably the most interesting recent developenent is the manufacture of oil and maint fuel from coal. The United States, powersing abundant natural supplies of petroleum, has surrendered the lead in this to chemists of Germany. France and England, where the cetural supply is limited.

Four processes have been developed.

NTHE first, the coal is beated to a cherry red, at about 1800 degrees E, which drives mit most of the oil and gas. The solid residue u an excellent smokeless fuel, resembling soft coke. The twenty-five to thirty gallons of tarry oil obtained from one top of coal may be "cracked" to yield five or six gallons of a guardinelike motor fuel. About 5000 cubic feet of rich gas is also obtained from one ton of coal.

The second method, the Berglus liquelying process, changes from thirty to fifty percent of the weight of the raw continto oil. Powdered coal mixed with enough oil or far to form a thick paste, it pumped with hydrogen gos into a steel cylinder, producing a pressure of \$000. pounds to the square inch which forces the sydnigen into combination with the coal, converting it from a solid to an oil. From 100 to 140 gallons is obtained from a ton of coal and refined into gasoline, kerosene, fuel and olla.

Refining of the oil in produce gasoline is obviated by "catalytin" processes developed to the Badische Company in Germany and by Patart in France, to make a pure synthetic motor fuel direct from coal gases. Water-gas, made by passing steam over red-but coke or coal, a pumped up to enormous pressure and passed through copper-lined steel tubes heated electrically to a temperature of about 750 degrees F Zine and chromoum compounds in these tubes cause the gases to form esettanol. A ton of coal yields about 125 ga tons, two gallons of which will drive an automobile as far as one go son of gasoline. Estimated manufacturing cost, however, is between twenty and thirty cents a gollon. hence it is out of the picture for automobile fuce at present.

Dr. Frank Fischer of Germany is producing the most interesting of all these synthetic fuels. Recently be exhibited true gisoune, lubricating oil and solid paraffin, all made from rous. He passes water-gas over cata year consisting of iron and cobalt heated to about 550 degrees F

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Here Are Correct Answers to Questions on Page 63

- 1. The town of Hammerfest near the northern extremity of Norway bettlements farther north in Spitabergen and at Etah, Greenland, are not large enough or permanent enough to he called towns. In a straight line Hammerlest is only about 1300 miles from the North Pole.
- 2. The quality of the milk used and the cure taken in the churning have combined to give Danish butter a world-wate reputation. It is ank) as a manny almost everywhere, even up Australia and New York.
- 2. Off the mouth of the Amazon River, whose power takes it that for
- 4. In Australia the government, in order to reconvile certain native tribes to the laws against wife-beating, whips wives for husbands who can prove them guilty of wrong doing. The more law applies to gualty husbands.
- The large variety of one shelled we would known as the alwayse is an initialisant of many of the shares of the Pacific Ocean, especially on the Isla de Cedeus or "Isle of Cestars, on the west side of the Bay of Subustian Viscoino.
- This is true of Sitks and to some extent even of the city of Juneau, a little further north. A current of warm water flows across from the coast of Japan and warms the Alaskan coast.
- 7. Goldfish of the colored varieties do not live wild anywhere to the world. They are raised for market, just as fine dogs are. The largest goatfish farm in the Luited States is sear Martinsville. Ind. The fish also are raised in large numbers in Maryland, lows, and NATISES.
- II. This cursous name is given to the flat. lakelike expanses of hard clay that are encounteres) in the levert parts of California and Nexuela. In most cases these clay plants really are the bottoms of ancient lakes.
- These the famous Lake Magndi, south of the town of Narrobs in Kenya Colony. This lake is a small, direct-up remnant of a larger lake. At the buttom is a bed of crystallated such of the kind known as washing sofa. It is shapped to hampe.
- 10. This word comes from two Greek words and means literally with the feet opposite. It is given to the countries directly on the other saje of the earth from porthwestern t Europe, especially Australia. The reason for this name is the fact that people living on the opposite side of the mirth from us have their feet koward ourse
- 11. In China, Japan, and more or less generally throughout the Far East, religious perwine write prayers in paper, which is then burned in a ceremonial fire. It is possible to buy in the market places bits of bright colored paper on which prayers have been prested in advance, all ready for use.
- 12. In the year 586 B.C. Nebuchadnessur, King of Babylon, captured Jerumlem and burned the famous temple, which had been built nearly 400 years before by King Solomon. The temple was afterly destroyed been the site of it was forgotten. It is now believed, however, that it sloud on the crest of one of the lights, galled the Eastern Hill, of the moslern city of Jerusalem. The temple probably stood not far from the so-called Sacred Rock, over which now stands the Mahammedan building known as the Mosque of Omat.

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The Movie Maker

(Continued from page 58)

approximate locations he was to 6nd and photograph. He also informed Boso that he had wired for reservations on a fast boat be-

tween New York and Laverpool.

That evening Don hurried home, whistling thoughtfully. In his pocket was the signed lease and contract, ranning for four months. At the conference in Echetean's office that afternoon, Margaret Moreland had apprared and, much to the surprise of the president of Popular Players, had added her signature without protest. As Don climbed the two flights to his attic apartment, his mind was busy with schemes for the immediate raning of further cash. He had sold Margaret a sapphire rong that morning for six thousand dollars. Reluctant to accept aid in such a fashion, he resolved that even if the picture failed bewould aventually repay her. But now it was to her advantage, even more than to his own, to throw everything into the balance for immediate auccess.

HE STEPPED into his apartment quetly, unnoticed by the professor, who was deeply absorbed at a long table near one of the

windows,

Don's home could be called an apartment only through courtery—or imagnation. In reality, it was a workshop where he and the professor stept. Originally it had been the ample, undivided third story in a huge old house in a disapplated section of Los Angeles, but Don had partitioned it into a small bedraum and a very large, unadorned studio. One windowless side was boarded off into a dark more. On the north side, he had cut a large square out of the roof and onestructed, with

fair skill, a ground-gloss skylight.

All about the big room was a clutter of photographic background screens, motion pieture lighting standards and paraphernalia, and an underly langle of electric wors. The most interesting parts of the studio, however, were the professor a long worklable and the shelves he had built against the wall near by. The old man a interest in the technical side of motion pictures apparently had hard into (cl. bloom that night, three years before, when Don had unexpectedly met him coming out of a neighburhood picture house. Since then, Professor Mahrlenhurg had spent hours every day making perfect minutures of motion picture scenes and properties. Three shelves were crowded with ancient ship models. Filling three other shelves was a soo of perfectly constructed animals of every nort and description, including tiny prehatoric monsters. Painted masks that seemed gratesquely alive stared down from the top shelves.

ON A long table, over which the old man was herding so intently that he had not heard Don enter, was a clutter of wheels, steel spirals, and numeror machinery. Pecuair geometrical designs cut out of metal disks or paper mache were stacked lossely at one end of the table. On a small rack before him were arranged a dosen disks of a different type, such a little larger than a silver dollar, but of varying thicknesses. Some of these were glass, but the majority were fine pieces of grune or transparent silk drawn tight in little metal rags. The professor was examining a similar disk under a large microscope champed to his table.

He looked up triumphantly when Don spoke.
"This one dried perfectly," he announced
"My Gretchen will look like sixteen when we

use it on the lens."

He placed the disk in the rack with the others, took from his eye a small magnifying glass he were like a monocle, and smalled mysteriously at Don.

"I have a surprise for you, my son," he remarked. (Continued on your 108)

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The Movie Maker

Continued from page 1679

Only slightly interested, Don waited while the professor put on his spectacles with great neremony, fumbled at length in his pocket, and drew out a long slip of paper. He handed it to

It was a certified check, signed by Otto Makrienburg and payable to Donald Kennedy,

for twelve thousand dollars!

Dun stared blankly from the check to the professor and back to the check again. Yes, it was certified. But where could the old man have obtained such a sum? He had been pearly starving when Don had taken him in. and he apparently had no friends. While losing with Don, he had worked up a small business of amateur kides, pretore finishing, making enough for his small expenses and for the materials needed in his model making. But, he could have naved an money. Don teas sure

YET the professor was souling blandly, as though accustomed to giving away thoumade of dollars every day

It looks real." Don commented, rubbing the check between his fingers. "It feels real and, by golly, I believe it as real, but how m

The professor sectored sightly embarranted

My daughter-

"We can't take any more from Mos More-

land! Don interrupted.

This money my daughter deposited for me in a bank years ago," explained the old man with dignity

"You mean you could have had it three years ago when you were practically starving? asked Don speredulously.

The old man drew himself up in injured

It is for the father to support his daughter. not the daughter her father he declared. "Now only, can I use it because it will be for

September first Cinema City was almost depopulated. Two or three smaller independest companies continued production there. but with the log units of Popular Players gone. the place looked described. At one and of the lot, however, several workmen were eresting ten-fool wooden supports in the form of a hope circle. From this goup a long-region young man, his red but theming to the sun, walked rapidly across the lot to Stage No. 3 He harned movie the bug shed to a dismantled set where three of his little company awaited. lun, dressed in medican) cost much

"Fine! He looked them over critically " How does it feel to be an actor again, Jerry?

"Right this minute 1 d like to be morning five thousand feet up, with a cold wind blowing me through the clouds." Jerry wrighted uncomfortably in a heavy costume of chain mail. This is not my idea of a Palm Beach suit.

"We'll start abouting right away," promised. "Only a few close-ups today. Miss Moreland, are you reads to run through a spene". Lid like to see how deers registers

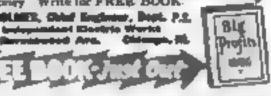
What he really wanted, however, was to test a combination of lighting effects and the professor's less screens on Margaret. He had watched her work under other directors and believed that the stramed expression of her face was due partly to her fear that she was failing. Now, chatting casually about the vers modern and highly efficient mechanical equipment of the stage, he apparently concentrated on Jercy, asking Margaret occasionally to help the greenborn actor put across his scenes.

The play was a story of the great wat, with Jerry an aveitor and Margaret an English war noise in France. This was only the shell of the story, however, for when Jerry crashed just behind the cucyay (Continued on page 169)





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The Movie Maker

(Continued from page 168)

lines and crawled out, wounded, to lose conecrousness on no man's land, his halfueinations took him back to another life—to England of the twelfth century at the time of one of the Crusades, when he was a Norman noble and Margaret a baxon lady. The action of this central part of the story concerned Jerry a adventures as leader of a hand of crusaders. To be near him, Margaret degrased herself as a knight, taking Judy, her little maid, along as a page. The journey through Engand and France, over the Alps, across the Mediterrabean to Constantanople, and on to the stege of Jerusalem, gave an opportunity for a spectacle motion picture of colorful adventure. Boso Biddle and his camera were to collect the local color and send it back in cans of firm across the Atlantic, while all the actual adventuring was to be done on the lot at Cinema City.

THE sequence Don had chosen for his test was designed to take place near the castle in old England. To control his lighting effects, he had decided to photograph the scene on a three-sided box set of Stage No. 3, lined with heavy white musin. As he set the camers in position, he called Jerry's attention to the huge electric light hulbs, protected by wire housings, which were mounted on a bridge above the set.

"That s why I chose this stage," he explashed. "It a the only one un the lot enumped with meandescent to ups in place of the carbon bridge ights. Stand here, will you, Jerry?

"But think of the price they I we, feeted Jerry, taking his place about as feet in front of the camera. "Wouldn't carbons be much cheaper'

"Nut when you figure salaries," explained Don. equinting at Jerry through the finder. "There must be a man to every two carbon lights, as well as chief electrician, and we use at wast ten carbons for any interior, sometimes eighteen or twenty-Msse Moreland, will you take your place here! - and the men are on the payroll eight hours a day, even if we use the lights only fifteen minutes. But one man can operate the whole row of electric bridge lights. That II save us thousands of dollars."

"beloon again to the rescue," marmired

Satzsfied at last with the camera angle, Don handed Judy a tape line. While she held it even with the lens. Don stretched its length to Jarry's nose, then stooped and chalked a rough semicircle on the foor. Cautioning these not to step outside the mark, Don moved to the awstrhlass at one side of the set and threw on the full blaze. From the scaffolding above, thirty thousand walts of electricity rained down on them, thooding every square foot of the set with even, shadowless illumination.

AND then Don began to paint out the fines and bollows of Margaret's face with additional light. A baby spot, focused to spread its rays just below her chin, removed a wrinkle with pastless surgery. A bank of mercury lights, placed low on the other rade to throw back a counter light against the downward glare from the bridge, erased the laughing lines from her nose to the corners of her mouth. The tiny crow's-feet about her eyes, the faint vertical lines between her brown, no light manipulation could remove, Don knew. These he left to be iround out by the microscopic diagonal threads of the professor's screen. So pping it into place over the lens, be called for action and began to crank the camera. Next week he would have a camera man, but for the first few days be wanted to test every operation himself. A few days and several hundred feet of film sacrificed for experiment at the beginning of the picture would save weeks of delay and thomsands of feet from being wasted inter. (Castimum on page 179)



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The Movie Maker

(Continued from page 169)

Jerry and Margaret, with Judy appearing briefly now and then, ma through their syene lightly, with a good comedy touch. Don-gramed appreciatively as he observed Jerry putting in bits of action that had not been rebearsed. He had no fear for Jerry's performance. The asan was a born actor. Entirely without self-consciousness, his thoughts translated themselves into action and focul expreuman without effort. And being blowed with a keen sense of humor, he enlivened any scene in which he appeared. Don wondered if the leading man might not unconsciously steal the picture from the star. But Margaret was playing up to him with a dash and ununation that revealed an unknown phase of her ability as an actrem.

LATE that afternoon the five met in the projection muon to see the first rushes of the bog picture, and a little sigh of pleasure sounded in the darkened morn as Margaret's face appeared on the screen. Firm, rounded, alive with vivacity, the beautiful face looked as though a kind hand had evept over it. smoothing out all telliale lines and bollows. Hut who was the gleastly-faced man playing apposite her? Only the sparkling dark eyes were Jerry; the rest was a flat dead mask, grimacang.

"What is the matter with him!" grouned

Judy.

Ton much make-up, muresured Don. "But we had to lay it on thick, protested Jerry's duappointed little noter, "he's ma daurk.

When the lights went up, Jerry faced the

others with an apologetic gris-

"If I had any wanty," he remarked, "I d never got any farther than doubling for the handwere here.

"I once over to the stage again," suggested Don. "I'll try more more shots if you don't mind. No need for the rest of you to stay

For three hours, until even Jerry's tanned and toughened skin began to feel tender, Don made up his face with different shades of greater point and powder, shooting a few feet of film for each new make-up-bravy pink, firsh, chalkwhite, pale yellow. One test he made with Jerry's skin in its natural state. This showed the best results in the projection from pest day. But even so, though the ghastly effect was overcome, he looked as awarthy as a Meucan laborer

That II be fine when he doubles as his villamous half-brother," commented Don, findang a ray of hope in the gloom.

YES, but how are we going to fix him up to look like the here?" asked Judy, almost in despair. In rewriting the scenario so that Jerry could play the double rôle of hero and villam. she had congratulated herself on many the mlary of an additional actor. Now it looked as though a new leading man must be hired.

"Why not have Louis Menues diagnose his face?" Margaret suddenly suggested.

"The amke-up winard?" asked Don. Yes. I want him to belp me with my own,

The worried five piled hopefully into Jerry's car and set out for a small dark bousting in Hollywood where for ten years a httle man with stubby fingers had been procticing his art of shiming the stars whose luster was failing bringing back the peach bloom of youth with the right shade of grease point, straightening erooked noses with a shadow pencil, concealing sears, and imparting natural curves to flat, expressionless lips.

Longs Menzies frowned and shook his bend. when he had seen the tests.

You couldn't fade him out successfully."

be indicated Jerry, "even if you whitewashed

What can we do with him, then! asked Don, as despair settled over the little group. Louis Mennes was functing among the

boxes and buttier on up the delver

"Lee this." He handed Don a stack of dark octive grease paint

Not it a almost brown!" protested Don. "He II look like the end man in a minutel

"Lee it' communited the wighter, and turned his attention to Margaret.

Rouge a little I giver and toward the nuter edges of the eyes," he suggested, "about here." Tilting her clun, be turned her face toward the bight and dablied her chiek bones near the temples with a puff filled with rose-pink rouge "It will take away that little flatness caused by lack of standows

"And this young lady," he looked at Judy, "must use a pale fiesh grease paint

But I m almost as dark as my brother,"

the remarked, wonderingly "No matter," replied the great man, "We expect women to have white skins on the serees and your eyes will look twice as large

and like black velvet. Louis Mension facial prescriptions were followed exactly, and the next day's rushes abowed a new and handsome Jerry, with elege. olive-finted akan.

"SOME sheik — exulted Judy —"They Il have to deliver his man in brokel lankets when the lady fans see our poture.

that Jerry reneved that has face upo no longer delaying production, gave his sister a mald shake and horned out to more important business on the lot with Don-

Within the circle of supports erected the week before was stretched a huge canvas, like a toplem circus tent. Waiting outside was a man with two boautsful chestnut horses. Jerry took the bridle of the larger one

"You might tether the other in the chade of that tree over there. he told the man. "Most Moretand was t good it for an long or so.

Following Don, Jerry guided his horse through a flap in the canvas. In the center of the ring the new camera man, Timothy O Day, was adjusting the tripod of a revolving, motors driven camera

"Att set!" asked Don, walking over for an ричрестион.

Just about, Mr. Kennedy. I'm ready to

Hop on, Jerry anstructed Don, "and walk your horse around as near the canvas as you can get without hampong it

Jerry dal as requested. The camera lens followed him slowly around keeping him in the center of focus as he made the circuit.

"Now trot."

Don set the revolving mechanism at a faster page and, as nearly as be could judge, it kept the lens still centered on Jerry

NOR nearly an hour, without exposing any A birth, 1900; and the comers man so, whel and readjusted the mechanism and rehearsed the action, turing it with a stop watch, wo ac-Jerry put his borse through its paces at several distances from the camera, but access making a complete circle around it. On the 6 m, of course, be would appear to be riding along in a straight line. Don had figured out the scheme as a short cut for a "running shot" a scene usually photographed from an automobile following along beside home and rider

When they were ready to make the exposures they sent for Margaret. Dressed in a long, forward gown, with a veil flying from the high peak of her medieval head-dress, the entered the inclosure on the other horse. They re-(Continued on base 172.

The Movie Maker

(Continued from page 170)

sequence quickly with her, keeping strictly to the time allowed for each bit of action. Finally Don was satisfied.

"All ready, Tim," be mid, taking his place at the camera man's cloow. He would have to remember to stay there in order to keep out of fine with the swinging focus of the lens. Lifting a small megaphone to his lips, he called to the two on horseback at the outer edge of the circle.

" Ready -action!"

Toward evening the little company gathered in the projection more for the day's reahes. The first shipment of films from Bose had arrived the day before and Don had them also thrown on the screen. Hundreds of feet of English countryside with a grim old castle frowning in the background; a bridle path awing an agreent most and following a brook, a suppy lane with dames nodding at either side; n wells road with giont oaks arched above. But not a sign of human being or habitation except the ancient castle, necessionally looming large in the foreground. The camera now and again caught a raboit scampering across the line. And once, in his swift flight up the broad. trunk of an oak tree, a bright-eyed squared paused for a curious second to stare into the PHI.

THEN on the screen appeared two figures riding on horseback apparently miles and miles against a blank white background. Judy maded nervously

They look so—so uncanny riding along to space," she commented, "as if the earth had suddenly dissolved and left them sticking up in the air."

"Tomorrow you'll see them in England,"

primised Dog.

Though he had spoken with such assurance, that night at home in his dark room he worked with tense anxiety to make his words come true. Would his precious machine, on which he had spent years of labor and thousands of dollars, full him now that the moment for its but performance had arrived? It had proved out well in tests, but Don was acquainted with the occasional perversity of manimate objects. In the early stages of his invention he had all hut sold a half interest in it for two thousand donars. At the ention moment, however the machine had unaccountably backed, and before Doe could locate and real, ust an innocent looking aftic screw, the entire process had been thrown out of alignment a sixteenth of an meh, ruining the demonstration. Don's propective partner had departed with his two thousand and a bearty laugh.

In the vience and dim red glow of the dark room, only the excited breathing of the professor could be heard as he helped Don with the developing and printing. But in Don's memory that laugh echoed. He set his jaw and his hands moved more deftly. Some day that laugh would be worth half a milhon on the credit side. Two or three pictures like "The I rusader." and mution picture producers could not fail to recognize the mormous economy of his universal background device. Two or three

pictures—if successful!

BIT there was no time to be dreaming of that now. Using a homemade machine, he put a positive print of the horseback scenestaken that morning through a strong solution of silver nitrate, allowing the film to sook in the solution until the figures of actors and horses became intensified as black silhungettes on a white transparent background. In order to preserve the original background negative sent from England, Don had had a duplicate negative made from it at Popular Players laboratory. This he intended to use in making his combination negative.

When the

(Continued on page 172)



If you want financial independence read the story "How a Big Load Was Lifted from Harry Wilson's Mind" on page four of this issue.





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The Movie Maker

(Continued from page 121)

dry, he took a strip of unexposed positive and adjusted it on his machine. Over it he fastened the English background negative, and on top of that he piaced the print of the silhouetted figures on horse-back. Tightening the delicate mechanism of his device, an intricate deboration of an automatic printing machine accurate to a ten-thousandth of an meh, he can the three strips of film together through the printing machine accurate.

The result was a positive print of the English background with the blank outlines of norms and actors superimposed upon it, the silhouettes formerly black now showing up white and transparent when the print was run through the developing hypo. After allowing it to dry on a revolving rack in front of a large electric fan. Don placed this new positive over a fresh strip of negative film, and on top of the two adjusted an ordinary positive of the historical stripes in Department the double printing princess, he obtained a perfect combination negative showing Jerry and Margaret rading against the English background.

IT Was two o clock when Don held a few frames of the completed negative against the ruby light and with a magnifying glass noted the exact placement of the figures. Relarged on the screen, not the slightest deviation would show. Now to make a positive print to run in the projection room the following day

The preferent had been gently shoring for hours in the most more, but it was dawn when Don, too happy to know he was tired, tumbled into bed.

In the busy days that followed, however, many problems called for indution. Hose had shown almost a grains for finding locations to fit the action of the sentano. His timing records, furthfully included with each real sent across, were models of accuracy and from had bitle trouble as networning with them the action about against blank harkgrounds so themselved an improvisive combination of action with backgrounds, Judy was called upon to do some rewriting, I sually it was a simple matter, but one day she rebelled.

I out I rewrite this seems, Don-toere's no way to do it! Jerry's just got to loop the charm or we'll mon the beg thrill we need at that

I know R," agreed Don. "But I don't see how it's possible to track our way this time."

JULY studied the still picture Boso had Juken from the bottom of a deep garge. The two sales of the ravine rise up sheer against the bosison, the tup apparently two buildred feet above the level of the camera.

We might find a kinstion something like it in one of the entirons around here, she suggested "Can't waste time himling for it report Doc." Besides, I don't like to have Jerry take

the risk of leaping such an ungodly hole."

"I don't either," admitted Judy. "Let's ask the professor of he can't help us out."

Professor Mahrletburg had appropriated one of the deserted stages as his workshop, and there they found him supervising the construction of combination large and ministrate acts drawn to scale from the photographs Boso had sent of interior scenes, the countyard, and the drawbridge of the old matte. At one side of the workshop, near a large window, an artist was reproducing part of a photograph on the upper portion of a large glass acreen set in a modeled frame.

"Let me keep the picture and study it," the professor said, when they had explained their problem. "Maybe I can manage, but I must first work it out on paper."

Two days later, under his directions, a small model of heavy (Costanuel on page 177)





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the transfer of the tarm of the transfer to the transfer of th

The Movie Maker

(Continued from page \$53)

cardboard, buriap, and artificial foliage, with tiny trees at its base, was set up near one end of the lot. It was a four-foot replice of the gorge, but extended not quite to the top shown in the photograph. This omession was supplied eighty feet beyond the model and directly in line with it where the professor had two sturdy platforms constructed, aftern feet in height, the distance between them apparently a continuation of the tiny gap between the sides of the model in the foreground. Over the platforms the professor caretessly draped rough grass mats, holding them in place with several large stones, a small log or two, and bushes. The pratform at the right extended beyond the camera angle into a runway upon which Jerry a horse could get a good start for the leap. A painted back drop behind the platforms completed the set

When Jerry was ready, Tim O'Day, with the enmera ats feet away from the minuture set,

found the focus.

fake a squant at that, ' he said to Don. "It a tricky

AND when the day's rushes appeared on the acrees, it proved "tricky" indeed—a perfeet illusion. Jerry remed in his galloping horse at the very edge of the chasts, apparently a dumy two-hundred-foot drop. For one breath-taking moment the splendid creature balanced there, his forefeet high in the air. Then he whirled and galloped away. Again Jerry urged him on and the borse took the chasin in a mighty leap-

The end of September was rushing toward them with the speed of an express train when Don, immersed in the rapid solving of each lay a difficultion, studenty mor the Big Problem looming immediately before him, It was Baturday moon and he had just finished passing out the weekly checks to their small number of employees. Judy was waiting for him in the office when he returned to discuss a slight change in one sequence. But his suchles glumpse of the Big Problem had shut everything else out of his mind.

July he exclaimed, sitting down at the table beside her. "We ve just three thousand left and next week I've got to rend Hoso more money and pay the electric light buts.

"So I ve been thinking," replied Judy "And what are you planning to do about it?

' Gosh! Dun mopped his forehead with a dingy handkerchief. ' Thought I d have the picture for enough along by this time to show it to some no honaire and get him to buy a share as my invention."

"AND what millionaire have you in mind?"

"No one in particular Don looked troubled. "The truth is, I got so absorbed in muxing the picture I forgot all about the money end of it

"West, even if you did know anyone with money and you don't," commented Judy te pfully, ' no one could make head or tail of the picture in its present state."

I know it, " grouped Don. "Guess I'B have to drop everything for a while and find some other way to sell shares in my machine

"And get cheated out of your rights in it)" scolded Judy. "Don Kennedy, you're no **Бычшем такт**

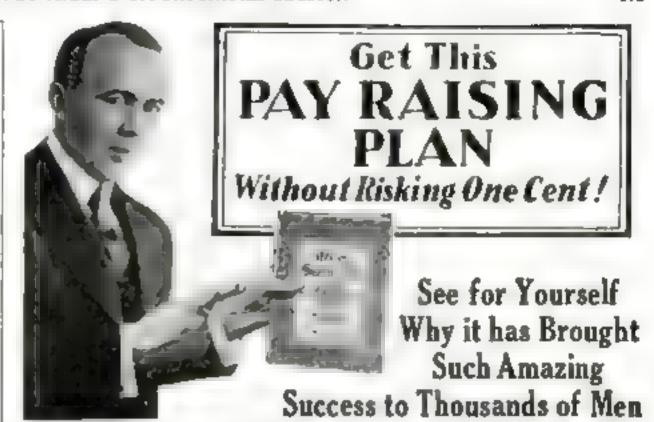
The no s luxe it agreed Don mournfully Leaning his thin on his hand, he shanped against the table for a descouraged moment. Judy gave him a motherly put

"How would you like to have fifty thousand dollars?" she asked brightly

"Don't be a piker!" Due ground at her eymently, "Wish for a million.

Judy considered him with thoughtfully narrowed eyes.

I am regel on page a be



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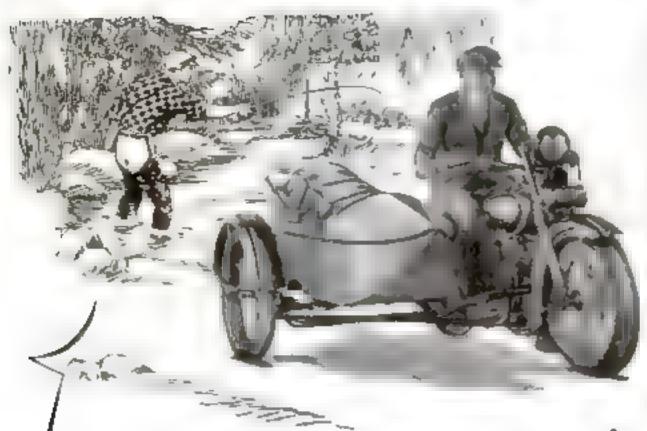


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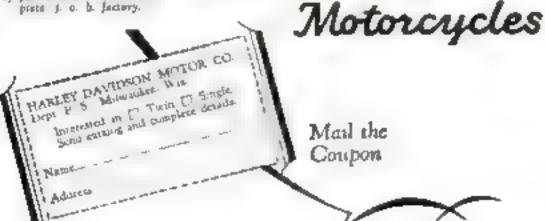
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HARLEY-DAVIDSON



The Movie Maker

(Continued from page 175)

"I know a girl who wants to get into the movies," size announced casually.

"Do you know any girl who doesn't? perted Don. "But maybe your friend owns a beauty contest rup!"

"tib, no. You can get that kind by the barrel. Judy dismussed the multitude with a shrug. "My girl owns a father and her father owns a string of newspapers from New York to San Francisco!"

"value Hogers exclaimed Don. "I heard he was coming to Los Augeles to start a new

"He and his daughter are here new," Judy informed him. "We lived in the same town when Mabel and I were little, so I looked her up when the papers announced her arrival. Mabel a dying to meet you!"

"Oh, m you've got the scheme all laid out?" Don looked at Judy suspiciously

"I HAVE! It's about time someone thought of money." replied his defiant account "Mahel's father is taking her to Everglade Grove pert Tuesday night and the five of us are just going to happen in and Maher will invite us to their table and.

"And we'll take the fifty thousand and tip the bond waiter!" quoted Don. "Your acheene nounds weak to me, but maybe you can put it across. You'll have to count the professor and me out, though. No clothes.

"You can buy some!" Judy retorted tartly "That's why I'm giving you till next Tuesday. (set a tur for yourself and a swallowtail for the professor with all the accessories."
"No." Don's tone was final. "My cords

"No." Don's tone was final. "My cords and the old blue serge will have to do me till we get this picture out of the woods."

If you want to be successful you've got to look that way. Jerry's getting a new tus, Margaret has promised to deck herself out like the Queen of Sheha—and I think you'll like my new dress." Judy smiled with pleasant self-approval. Then she turned a severe frown on the shabby young director. "Don, for once an your life you've just got to look decent!"

m your life you've just got to look decent!"
"Thanks for the implied compliment," Don replied, unsmiling. "But I is wait till I can spend my own money for clothes. Don't forget that I is living on your brother's charity and using Mus Moreland's money for the picture!"

JUDY stared at his unrelenting chin, at his primly steady, tired eyes. Suddenly and quite unexpectedly, she had to gulp back a sob. she blacked her eyes quickly

"It it cost only about two hundred dollars to buy those dother and give us a chance at the fifty thousand—and if we don't get the lifty thousand, what good will the two hundred be to us? We'll be sunk! You've been grubbing along for five years and—

"And I haven't put anything across." Dun finished for her granty. "I guess you're right at that the only way to get ahead is to throw a big binfit" he concluded bitterly. Then he laughed at the meek little face opposite hungo unlike Judy a usually saucy expression. "Oh, well, I il give your plan a try. Tell me what you want me to do."

"Attaboy" A rambow of smiles broke over Judy s face. "Now we'll get the picture on its feet. You can't expect anyone to back you till

you put up a front!

It's a great scheme of Judy's—if it works. Fifty thousand dollars! That sum would carry them a long way on their desperate enterprise. But can they capture it? In next month's installment — more interesting adventures, and more fuscinating revelations of the installment percent of the movie game.



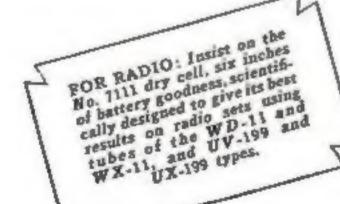
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